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Volume 16 Number 5

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March 15, 1962

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Volume 16, Number 5 **March 15, 1962**

NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

5104 (CF-60-10-62(Rev.1)) INSTRUMENTATION AND CONTROLS DIVISION ELECTRICAL DESIGN STANDARDS AND GRAPHICAL SYMBOLS. (Oak Ridge National Lab., Tenn.). Nov. 1961. Contract [W-7405-Eng-26]. 86p.

Copies are presented of the American Standards Association graphical symbols for electrical and electronic equipment and systems. Recommendations are given for electrical elementary design layout, device codings, etc., for permanent type installations. Electrical diagrams copied from American Drafting Standards Manual are presented. (M.C.G.)

5105 (NP-11179) THE APPLICATIONS OF ATOMIC ENERGY OTHER THAN CENTRAL-STATION POWER GENERATION. A Technical and Economic Analysis of Their Role in the U. S. International Atomic Energy Programs. R. W. Dayton, H. R. Batchelder, F. C. Croxton, S. L. Fawcett, H. W. Nelson, and W. T. Reid (Battelle Memorial Inst., Columbus, Ohio). Apr. 18, 1960. 209p.

An analysis was made to appraise the essential technical and economic background of each of many atomic-energy applications and to estimate the usefulness of each application to other countries at various stages of their economic development. The applications considered are: research activities in all fields of science, on and with the aid of atomic energy; use of reactors for propulsion, process heat, saline-water purification, space heat, and for promoting chemical reactions; direct conversion of heat and radiation to electricity; industrial use of radiations and of radioisotopes; use of nuclear explosives for earth moving and for heat; radiation preservation of foods; use of radiations and tracers in agriculture; and use of radiations and tracers in medicine. Where appropriate, each section of the report covers the following aspects of its subject: technical state of the art; research and development in progress; nonnuclear means for achieving the same objectives; present and prospective economic situation; applicability to the economy of other countries; and means for encouraging useful atomic-energy applications. (M.C.G.)

5106 (RM-2798-AEC) THE STRENGTH OF UNDERGROUND CAVITIES OF SPHERICAL AND SPHEROIDAL GEOMETRY. J. M. Green (RAND Corp., Santa Monica, Calif.). Oct. 1961. Contract AT(11-1)-135. 29p.

The theory of seismic decoupling cavities is examined in relation to the conditions under which an underground cavity might fail because the hoop stresses go into tension. The hoop stress is evaluated at the apex of a spheroidal cavity and is compared with the hoop stress at the corresponding point of a spherical cavity which is subjected to the same loading. It is shown that the maximum internal pressure which may be sustained by each of the cavities depends on the Poisson ratio. (J.R.D.)

5107 (SCR-163) ATMOSPHERIC SIGNALS FROM EXPLOSIONS AND THEIR INTERPRETATION. J. W. Reed (Sandia Corp., Albuquerque, N. Mex.). Dec. 9, 1959. Reprinted Nov. 10, 1961. Contract [AT(29-1)-789]. 24p.

A Talk delivered at Sandia Corporation.

Results are reported from a series of experimental high-explosive shots under inversion conditions at the Nevada Test Site which were made in an attempt to refine blast prediction techniques. Applications of the data in determinations of the amount of energy which remains in the blast wave as it reaches acoustic level and in determinations of the magnitude of the reflection factor when the blast wave strikes the ground are discussed. Data on shock wave propagation are presented graphically. It is concluded that the blast phenomenology of high-altitude shots can be predicted by using modified Sach's scaling. With some extrapolation to the height-of-burst versus blast-yield curve, it should be possible to make order-of-magnitude predictions of blast effects from high-altitude shots up to heights of burst of 1,000,000 ft. (C.H.)

5108 (TID-14418) PROGRESS REPORT NO. 58 [ON NUCLEAR RESEARCH] COVERING THE PERIOD FOR PHYSICS AND CHEMISTRY THROUGH APRIL 30, 1961. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). May 1, 1961. Contracts AT(30-1)-2098; NASw-37; NASw-75; and AT(30-1)-905. 173p.

Progress is reported on research and developments on nuclear chemistry, chemistry of fission elements, cosmic rays, high energy accelerator physics, bubble chambers, linear accelerators, Rockefeller generator, ONR generator, radioactivity, cyclotrons, and theory. (M.C.G.)

5109 (UCRL-6605) CLOSE-IN PRESSURE AND SHOCK ARRIVAL TIME MEASUREMENTS. Final Report Project SCOOTER. Jack N. Shearer, Robert G. Olson, and Otto H. Krause (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 8, 1961. Contract W-7405-eng-48. 30p.

Project Scooter, a part of Operation Plowshare, was a 500-ton chemical explosive shot fired at the AEC Nevada Test Site. Personnel of Lawrence Radiation Laboratory undertook a program of measuring pressure-time histories and shock wave arrival times. Tourmaline piezoelectric transducers were used for both purposes. Only one instrument, located 49.4 feet from the center of the detonation, gave usable information. At this distance the shock wave arrived 11.2 ± 0.4 msec after the X-unit signal, and the maximum pressure was 1.7 ± 0.5 kilobars. (auth)

5110 (UCRL-6636) NUCLEAR EXPLOSIVES IN MINING. William G. Flangas and David D. Rabb (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 26, 1961. Contract W-7405-eng-48. 42p.

Results of underground tests indicate possible applications of nuclear energy in mining and allied industries. The safety, feasibility, and economy of nuclear detonations have been demonstrated and further considerations reveal a number of interesting situations which might lend themselves to the use of this new type of explosive. Possible applications include stripping, crushing, quarrying, and the exploitation of petroleum products, development of water resources and low-grade ore deposits. Experience in the underground firing of nuclear explosives has indicated: that they can be contained, and therefore radioactivity is not an unmanageable problem; that seismic results are predictable and are of limited range; that surface effects can be determined beforehand; that under appropriate circumstances ground water contamination is negligible; and that mining operations in a blast area are feasible. If rock breaking and moving problems are big enough, nuclear explosives may offer the most economical solutions. Nuclear explosives can create conditions underground which are conducive to block-caving, a mining technique used prior to ore withdrawal or in-place leaching. The mining industry can supply test sites for practical experiments and has the know-how to help in the proper evaluation of the results. (auth)

5111 (UCRL-13028) MODEL STUDIES OF FRACTURING CAUSED BY BURIED EXPLOSIONS AND THE INFLUENCE OF GEOLOGIC STRUCTURES ON FRACTURING. (Colorado School of Mines Research Foundation, Inc., Golden). Nov. 6, 1961. For Univ. of California Lawrence Radiation Lab., Livermore. Contract [W-7405-Eng-48]. 99p.

A large number of experiments were carried out in which a small explosive charge, buried within but close to one free surface of a plaster of Paris block, was detonated and observed as to the resulting stress distribution, fracture pattern, particularly cratering effects, and velocities of propagation of the fractures. Complementary tests were run in which fractures were produced by static pressures, the intent being to compare dynamically and statically formed craters. The results indicate that for depths of burial near the limit of break out, fracturing is caused by the high quasi-static pressure developed by the explosion products in the camouflet they generate rather than the initial shock wave, although certain secondary effects due to shock waves were observed. Plane discontinuities of various types were introduced between the charge and the free surface and their influence on crater formation briefly examined. Results indicate that plane discontinuities reduce the tendency to fracture to the free surface and reduce the contribution of the stress wave to fracturing. (C.H.)

5112 (USNRDL-TR-525) RADIATION INSTRUMENTATION FOR THE CLASSIFICATION OF NUCLEAR EXPLOSIONS AT SEA. E. J. Wesley (Naval Radiological Defense Lab., San Francisco). Sept. 7, 1961. 53p.

A survey is presented of the measurement problems, environment and instrumentation requirements for the detection and sampling of clandestine nuclear explosion debris at sea. The survey is oriented toward the problems of a search team policing a world nuclear test ban and recommends improvement of existing water probing devices and development of a ship-to-water survey system and expendable depth probes. The depth probes would explode a charge on contact with submerged radioactive pools and this signal would be monitored by the ship's sonar. (auth)

5113 EFFECTS OF NUCLEAR TESTING ON DESERT VEGETATION. Lora M. Shields and Philip V. Wells (New Mexico Highlands Univ., Las Vegas). Science, 135: 38-40 (Jan. 5, 1962).

Detonation of fission-type nuclear devices results in an inner circle of complete denudation of desert shrub vegetation, often about 0.5 mi in radius, surrounded by a zone of partial and selective destruction which is variable in width. The gross injury to vegetation appears to be attributable to mechanical and thermal effects. Successional change in the composition of the vegetation, due to invasion by plants of pioneer character, is taking place in all disturbed areas. (auth)

BIOLOGY AND MEDICINE

General and Miscellaneous

5114 (A/AC.82/G/L.661) GONADAL AND BONE MARROW DOSE IN MEDICAL DIAGNOSTIC RADIOLOGY. K. A. Mahmoud, M. M. Mahfouz, M. E. Mahmoud, I. R. Atiyah, A. M. El-Naggar, and M. M. Moloukhia (United Arab Republic. Atomic Energy Establishment, Inshas, Egypt). Aug. 1961. 18p.

Measurements were made of the active mean bone marrow, integral bone marrow, gonadal, and maximum skin doses from diagnostic x-ray procedures used in Cairo University Hospitals. The active mean marrow dose in cervical, dorsal, and lumbar spine diagnostic exposures were found to be somewhat smaller than those reported by some western countries. One of the most striking results of the survey was the relatively high values of the urinary tract cases investigated diagnostically; owing to the high incidence of urinary tract Schistosomiasis. The gonadal dose delivered to males and females was found to be almost negligible for all diagnostic investigations of the spine, except for the lumbo-dorsal region which was within the range 50 to 500 mrads. It was also found that the gonadal dose was significant in investigations of the lower gastrointestinal tract, gall bladder, and urinary tract. (P.C.H.)

5115 (NP-11172) USE OF URANIUM TO CONTROL MARINE-BORER DAMAGE. Progress Report No. 1. (British Columbia Research Council, Vancouver). July 14, 1961. For Canadian Uranium Research Foundation, Toronto. 8p. (CURF-R-13)

Activities in a program are reported to prepare a U-organic compound which is toxic to *Limnoria tripunctata*, a marine borer. Details of the experimental plan are given along with a discussion of analytical procedures and biological specimens procurement. (J.R.D.)

5116 (NYO-9573) A STUDY OF THE EFFECTS OF SUB-STERILIZATION DOSES OF RADIATION ON THE STORAGE LIFE EXTENSION OF SOFT-SHELLED CLAMS AND HADDOCK FILLETS. Quarterly Progress Report for period August–October 1961. John T. R. Nickerson, Samuel A. Goldblith, Edmund B. Masurovsky, and Joseph A. Licciardello (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2329. 45p.

Data obtained during the months of July and August, 1961 on the microbiological quality of haddock fillets and shucked, soft-shelled clams processed and marketed in the greater Boston area were compiled, analyzed statistically, and critically evaluated for commercial and sanitary significance. Analysis of the data by the techniques of analysis of variance and the Duncan Multiple Range Test indicated that statistically significant differences ($p = 0.05$) existed in the populations of aerobic-facultative microorganisms associated with haddock fillets processed during the morning, noon, and afternoon filleting and packaging operations of a given company, as well as between fillets procured from the different companies surveyed at a given time of day. Higher macrocolony counts were generally obtained from haddock fillets processed in the afternoon (approx 15×10^5/gram), as compared to those processed in the morning (approx 4×10^5/gram). Soft-shelled clams dug from unpolluted beds in the vicinity of Boston, when shucked, were found to have bacterial counts which were approximately one hundred times lower (c.a., 5×10^4/gram) than clams shipped in from Maryland and subsequently shucked in the local marketing area (c.a., 5×10^6/gram). Anaerobic (Clostridia) counts were somewhat higher in shucked clams than haddock fillets. Statistically significant differences ($p = 0.05$) were found in the product taken from the processing lines of different clam shucking plants at a given time of day; especially with the product from the morning operations. On the average, Clostridia counts ranged from 0.5 to 2.6×10^2/gram of the two sea foods in question. During September and October, 1961 the Mark I Food Irradiator was charged with 32,000 curies of Co^{60} and calibrated for the various experimental programs by Fricke (ferric-ferrous) dosimetry. Standard solutions and procedures were employed in the dosimetric calibration of the three irradiation chambers. Number 2 tin cans and 5 ml Neutraglas ampoules were used in the calibration determinations. Irradiation of haddock fillets commenced in the latter part of October and will continue, together with the irradiation of shucked, soft-shelled clams. (auth)

5117 (UCRL-9900) BIO-ORGANIC CHEMISTRY QUARTERLY REPORT, JUNE–AUGUST 1961. (California. Univ., Berkeley. Lawrence Radiation Lab. *and* California. Univ., Berkeley). Oct. 17, 1961. Contract W-7405-eng-48. 89p.

Absorption spectra are reported for spinach chloroplast fragments, and the effects of aging and bleaching on the spectra were studied. An investigation was made on the relationship of photosynthetic activity and production of photo-induced free radicals to the chlorophyll content in the greening of a yellow mutant of *Chlamydomonas reinhardi*. Electron spin resonance studies were made on chromatophores isolated from *Rhodospirillum rubrum*. Experiments are reported on light-catalyzed oxygen and hydrogen transport by xanthophylls in photosynthesis in spinach chloroplasts. The formation of alkyl phosphates in phosphate-fed spinach chloroplasts by treatment with alcohols was studied. RNA and DNA were estimated in spinach chloroplasts isolated by a nonaqueous density technique. F_f values are given for the paper chromatography of nucleic acid constituents in the two systems, propanol–ammonia–water and butanol–propionic acid–water, and two-dimensional chromatograms are plotted showing the relative positions of the compounds. Evidence is presented for the formation of heterocyclic bases (purines and pyrimidines) in $CH_4-H_2-NH_3$ gas mixtures over water and for the formation of amino acids and urea in aqueous HCN solutions upon irradiation with 5-Mev electrons. An investigation of the mechanism of radioinduced decomposition of choline chloride is reported. Progress is reported for the radiation effects on guanine and adenine. Qualitative data are presented for the color reactions of sulfur acids with electron acceptors in the presence of bases. The reaction of diethyl phosphonate with trinitrobenzene to form a complex was studied in absolute alcohol in the presence of tertiary amines. (D.L.C.)

5118 LEUKOCYTE LABELING WITH INORGANIC RADIOPHOSPHORUS. Richard I. Walker, John C. Herion, and Jeffress G. Palmer (Univ. of North Carolina, Chapel Hill). Am. J. Physiol., 192: 1137-41(Dec. 1961).

Plasma clearance of inorganic P^{32} given in a single intravenous injection has been evaluated. Significant levels of activity persist for at least 7 days following injection of only 2 μc/kg. Inorganic P^{32} uptake into various fractions of circulating leukocytes and into fractions of marrow cells has been studied. In marrow cells, equilibration of extracellular phosphate and intracellular acid-soluble organic and inorganic phosphates appears to be reached by 24 hr and probably occurs sooner. In leukocytes thought to be postmitotic at the time label is injected this equilibrium is not reached until 48 hr. In rabbits the postmitotic maturation pool is sufficient to replace circulating leukocytes for at least 48 hr; this defines the time required for cell passage through this pool under normal conditions. Significant desoxyribonucleic acid tagging from a single intravenous injection of P^{32} appears to proceed for several days. (auth)

5119 RELATION BETWEEN ^{59}Fe INCORPORATION AND MATURATION OF RAT BONE MARROW MEGAKARYOCYTES IN VIVO. S. K. Brahma, A. Bose, and S. Bose (Chittaranjan National Cancer Research Centre, Calcutta). Exptl. Cell Research, 25: 472-4(Nov. 1961).

The incorporation of Fe^{59} by the nucleus and cytoplasm of megakaryocytes at different stages of maturation was measured in 1000 cells. Results indicate that total incorporation of Fe per cell increases with an increase in the number of nuclear tabulation, suggesting a relation between differentiation and nuclear incorporation. (C.H.)

5120 IRRADIATION OF ONIONS. J. G. Van Kooy and D. I. Langerak (Inst. for Atomic Sciences in Agriculture, Wageningen, Netherlands). Food Irradiation, 2: No. 1, A6-A7(July-Sept. 1961).

Radiation processing of onions reduced neck rot in stored onions and inhibited sprouting only during the first 30 days of storage. Data are presented graphically on the effects of exposure to doses of 0 to 7.5×10^5 rad electrons. (C.H.)

5121 THE LOCALISATION OF BRAIN TUMOURS BY MEANS OF RADIO-ISOTOPES. PART III. F. Mundinger (Neurosurgical University Clinic, Freiburg i. B.). Medicamundi, 7: 127-30(1961). (In English)

Applications of positron-emitting radioisotopes in the diagnosis and localization of brain tumors are discussed. The emission of annihilation radiation from the union of an electron pair was utilized by means of two direction-sensitive detectors arranged symmetrically and equipped with coincidence amplifiers. Only those γ quanta of the annihilation radiation are measured that are incident simultaneously and in the line connecting the two detectors, which are attached to the head. The two mechanically connected counters scan the head lineally on both sides and the coincidence pulse rates are recorded by a printing mark. The biological behavior of As^{74} and Cu^{64} is discussed. Results are presented from a clinical evaluation of results in 133 patients in which these positron-emitting radioisotopes were used for the localization or diagnosis of brain tumors. (C.H.)

5122 RADIOACTIVITY IN WOOL. S. S. Brar (Argonne National Lab., Ill.), P. F. Gustafson, M. A. Kerrigan, B. C. Breidenstein, U. S. Garrigus, and W. R. Usborne. Nature, 192: 1094-5(Dec. 16, 1961).

Gamma-emitting radionuclides in wool samples were identified as K^{40} and Co^{137}. It was concluded that natural K^{40} activity is present in wool grease, suint, and dead skin in the wool. Cesium-137 is attributed both to fall-out contamination and sources present in the wool. (C.H.)

5123 RADIATION DOSE CALCULATION IN CELLS CONTAINING INTRANUCLEAR TRITIUM. Clyde Goodheart (California Inst. of Tech., Pasadena). Radiation Research, 15: 767-73(Dec. 1961).

A formula based on results of Robertson and Hughes has been developed for calculating the average radiation dose-rate distribution within a cell containing intranuclear tritium. The formula has been used to calculate a curve giving average dose rate as a function of distance from the center of a nucleus of 2-micron radius. The dose rate to the nucleus is about nine times that to the cytoplasm. The assumptions involved in making the calculation are discussed. (auth)

5124 AUSWIRKUNGEN ATOMARER DETONATIONEN AUF DEN MENSCHEN. (Effects of Atomic Explosions on Man). Otfried Messerschmidt. Munich, Verlag Karl Thiemig, 1960. 306p. DM 48.

Acute, subacute, and chronic injuries in Hiroshima and Nagasaki are discussed. Topics covered include a general survey of the nature and extent of the damages; burns as a result of the thermal radiation; injuries as a result of the pressure wave; injuries as a result of the initial radiation; course of the first, second, and third stages of the radiation sickness; clinical symptoms of radiation sickness; hematology of radiation sickness; therapeutic measures of the Japanese doctors; and pathological anatomy of the atomic bomb injuries. Ascertainable injuries among the population years later include organic injuries and functional disorders, leukemia and carcinoma formation, development disturbances and illnesses of irradiated children inclusive of the in utero exposed, and genetic problems. Results of the Bikini fall-out are also described. Topics discussed include the radioactive fall-out, its distribution, and the radiation originating from it; the clinical and pathological-anatomical state of the Bikini fishermen and the inhabitants of the Marshall Islands; radiation injuries as a result of the deposition of fission products on the skin and in the body; and results of additional investigations on the Marshall Island population 3 and 4 years after the rain of ashes. (M.C.G.)

5125 INHALED PARTICLES AND VAPOURS. Proceedings of an International Symposium, Oxford, 29 March–1 April 1960. C. N. Davies, ed. New York, Pergamon Press, 1961. 504p. $15.00.

An international symposium is presented on the behavior of animals toward foreign substances in the atmosphere. It is pointed out that radioactive aerosols, and the instruments which are available for measuring radiation, make it possible to ascertain in minutes the location and concentration of deposits in animals, which, if detectable, could formerly be assayed only at the cost of much labor. Topics discussed include the anatomy and physiology of the respiratory tract, physical and chemical aspects of particle retention, radioactive aerosols, vapors and particle-vapor interactions, pulmonary elimination and storage of dust, asbestosis, selective sampling, and pneumoconiosis. Subject and author indexes are included. Separate abstracts have been prepared on three selected papers. (C.H.)

Biochemistry, Nutrition, and Toxicology

5126 (A/AC.82/G/L.652) CS-137 BURDENS IN SWEDISH LAPLANDERS AND REINDEER. Kurt Lidén (Lund, Sweden. Univ.). Nov. 1, 1961. 5p.

The content of Cs^{137} in reindeers in Sweden and in the Laplanders who have a pronounced reindeer-meat diet was studied. Measurements of reindeer meat produced in the areas where the Laplanders studied live gave a Cs^{137} content of 24 nc/kg. The Laplanders showed a Cs^{137} activity 30 to 45 times as high as the average of 8.0 nc of the control group at Lund, Sweden. (M.C.G.)

5127 (ORO-480) INVESTIGATIONS CONCERNING THE TOXICITY AND PHARMACOLOGY OF YTTRIUM. Final Report. (Tennessee. Univ., Knoxville). Oct. 15, 1961. Contract AT(40-1)-2625. 12p.

Studies were made of the general pharmacological effects of yttrium chloride. The tissue response to drugs in the presence of various amounts of yttrium was also investigated. Selective depressant properties of yttrium on the heart were observed. The amount required for this was very small while tissues such as aorta, duodenum, and uterus withstood exposure in very large amounts. The presence of yttrium also selectively affected the response of tissues to drugs such as altering reversal of epinephrine to benedaine. (M.C.G.)

5128 (TID-14371) ION INTERACTIONS IN PLANT TISSUES. Progress Report, January 1961–January 1962. (Connecticut. Univ., Storrs). Contract AT(30-1)-2117. 8p.

Methods were devised for measuring the deposition of root-introduced phosphorus-32 in the xylem stream. The value was interpreted as an apparent indication of isotope penetration across the root. The measurement of the xylem sap volume, used in determining the changes occurring in the stream composition during penetration, is described. The results of the buildup of root-introduced phosphorus in the stems are shown graphically. (B.O.G.)

5129 (TID-14372) STUDIES ON BIOLUMINESCENCE AND ENERGY TRANSFER MECHANISMS. W. D. McElroy (Johns Hopkins Univ., Baltimore). Nov. 21, 1961. Contract AT(30-1)-2514. 6p.

The studies of bioluminescence and energy transfer mechanisms are summarized for the synthesis of luciferin, the rate and quantum yield of the firefly reaction, nonenzymatic luminescence, quantum yields of bacterial bioluminescence, and bioluminescence of marine organisms. (B.O.G.)

5130 (TID-14373) THE DEVELOPMENT OF CHELATING AGENTS FOR ENHANCING THE URINARY EXCRETION OF STRONTIUM. Annual Report, February 1, 1961–November 30, 1961. Report No. 1. Harry Kroll, Kenneth Wunschel, and Thomas Wolf (Eltex Research Corp., Providence). Contract AT(30-1)-2710. 33p.

Triethylenetriamine hexacetic acid (TTHA) was synthesized and tested for promoting plutonium excretion in rats. Work on the biological assay of this compound will continue. Ethylene bis(oxyacetic acid) was prepared and the stability constants of the Mg, Ca, and Sr chelates were determined. Chelating agents based on aminomethane disulfonate were prepared. Two of these compounds display a higher affinity for strontium than calcium but are unstable for physiological studies. A water soluble sodium polystyrene sulfonate was prepared, and an investigation on its metal binding properties is in progress. (auth)

5131 (TID-14388) RADIONUCLIDE CYCLING IN AGRICULTURAL PLANTS. Technical Progress Report for year March 1, 1961 to February 28, 1962. (Minnesota. Univ., St. Paul. Inst. of Agriculture). Nov. 1961. Contract AT(11-1)-783. 133p.

A complete soil survey of the field laboratory was made. Successful experiments were completed for the placement of P^{32} in the special soil plots of the field laboratory. Studies were continued on the loss of foliarly applied P^{32} from soybean and its grain by barnyard grass. Additional studies were made on the evaluation of P^{32} in soybean. Studies now include the circulation pattern from all the major foliar organs. The final distribution pattern of P^{32} from root applications of the radioisotope to soybeans was determined. The relationship between foliar absorption of P^{32} and its transport from the organ to which it was applied was studied. The pattern of translocation of Zn^{65} from the first bloom node leaf of pea to the flower and fruit at that node was studied. Studies on translocation of P^{32} in corn growing in the field were continued. (auth)

5132 (TID-14420) THE ACCUMULATION OF RADIOACTIVE ISOTOPES BY TROPICAL MARINE ORGANISMS. Annual Report 1960-1961. Sidney J. Townsley, Della F. Reid, and Winifred T. Ego (Hawaii. Univ., Honolulu. Hawaii Marine Lab.). Contract AT(04-3)-235. 36p.

Studies of the uptake of radioactivity by producers and reducers represented by an alga and mixed cultures of diatoms, by primary consumers represented by a mollusc and crustaceans, and by secondary consumers represented by the coelenterates from a Zn^{65} enriched microcosm are reported. The role of light and enzyme inhibitors on the uptake of P^{32} and Zn^{65} by the mushroom coral, Fungia scutaria, was studied. Preliminary experiments on the ability of this coral to remove dissolved organic matter (glucose) labeled with C^{14} are also reported. The ability of the green alga, Ulva lactuca, and the eggs of the ascidian, Pyura momus, to remove Cr^{51} from a sea-water solution are presented. Results of experiments to elucidate the mechanisms of hydro-mineral metabolism in the cichlid, Tilapia mossambica, are reported. The flux of sodium through this fish and hormonal control of the rate of sodium flux are delineated using Na^{22} as a tracer for Na^{23}. The quantitative contribution of stress to variation in sodium flux rate was measured. Results of preliminary experiments on the dynamics of P^{32} through a marine microcosm are reported. A study of the role of crustacean eyestalk hormones on the rate and quantity of Zn^{65} removed from solution by the portunid crab, Podophthalmus vigil, was initiated. (auth)

5133 (TID-14432) PATHWAYS OF METABOLISM IN EMBRYONIC DEVELOPMENT, Renewal Request and Progress Report [for period] June 1958 to December 1961. Clement L. Markert (Johns Hopkins Univ., Baltimore). Contract AT(30-1)-2194. 10p.

Progress is reported in studies of cell and tissue interactions and the successive transfer of essential functions from one group of cells to another during metabolism. The chick embryo was the principal experimental organism. Emphasis was placed on the structure and metabolic activities of the developing tissues of the chick, particularly the yolk egg sac membrane, the liver, and the eye retina, and on the synthesis, distribution, and properties of various enzymes in embryonic and adult tissues. The general phenomenon of isozymes, or multiple molecular forms of enzymes, was also investigated. A list is included of publications during the period covered by this report. (C.H.)

5134 (CEA-tr-A-1014) RETRODIFFUSION DES ELECTRONS DANS DIFFERENTS MILIEUX. (Backscattering of Electrons in Different Media). G. Breitling. Translated into French from p.169-72 of "Betatron and Telecobalt Therapy. International Symposium at the Czerny Hospital for Radiation Therapy of Heidelberg Univ., July 1-3, 1957." (A publication of Springer-Verlag, Berlin, 1958). 11p. (Includes original, 4p.).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 11868.

5135 (CEA-tr-R-1416) PROBLEMES DE LA TRANSMISSION DU STRONTIUM RADIOACTIF LE LONG D'UNE CHAINE DE NUTRITION PARTANT D'UN RESERVOIR D'EAU OUVERT ET ABOUTISSANT A L'ORGANISME HUMAIN. (Problems of the Transmission of Radioactive

Strontium by Nutritional Chain from Open Water Reservoirs into the Human Organism). A. N. Marei, M. M. Saurov (Saourov), and G. D. Lebedeva. Translated into French from Med. Radiol., 3: No. 1, 69-76(1958). 22p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 9631.

5136 ADRENOCORTICOSTEROID HORMONES AND MANGANESE METABOLISM. Edwin R. Hughes and George C. Cotzias (Brookhaven National Lab., Upton, N. Y.). Am. J. Physiol., 192: 1061-4(Dec. 1961). (BNL-5195)

An effect of two glucocorticosteroids on the transport of the essential trace element, manganese, is described. Mice receiving high doses of prednisolone or cortisol accumulated more radiomanganese in their carcasses and retained less in their livers than did untreated controls. In some respects this effect was similar to that seen when manganese salts were administered as significant metabolic loads. It was brought on regardless of whether the injected isotope was in the divalent ionic form or in the plasma-bound form. Treatment with mineralocorticosteroids alone did not affect manganese metabolism as tested here. Furthermore, Zn^{65} did not respond to the glucocorticoid effects exhibited by Mn^{54}. (auth)

5137 SPECIFIC ACCUMULATORS OF INDIVIDUAL RADIOISOTOPES AMONG FRESH WATER ORGANISMS. E. A. Timofeeva-Resovskaya, N. V. Timofeev-Resovskii, and E. A. Gileva (Lab. of Biophysics, Ural Branch of the Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 140: 1437-40(Oct. 21, 1961). (In Russian)

The distribution coefficients of 19 different radioisotopes have been determined for 32 kinds of fresh water plants and for 20 kinds of fresh water, animal life. Low accumulation coefficients are found on the average for S^{35}, Ca^{45}, Ge^{71}, Sr^{90}, I^{131} and Cs^{137}. High coefficients are found on the average for P^{32}, Fe^{59}, Co^{60}, Zn^{65}, Ce^{144}, Hg^{203}, Y^{91}, Zr^{95} and Nb^{95}. Average coefficients are found for Cr^{51}, Rb^{86}, Ru^{106} and Cd^{115}. The accumulation coefficients are higher on the average for plant life than for animal life. Specific forms of animal life are noted that show high accumulation coefficients for P^{32}, Co^{60}, Sr^{90}, Y^{91} and Cs^{137}. Single-cell forms of plant life and filamentary seaweed accumulate 6 to 8 different radioisotopes. Seven of fifteen of the radioisotopes are strongly concentrated by 5 kinds of animal life (out of 20 different kinds investigated), and 13 of 19 radioisotopes are strongly concentrated by 10 kinds of plant life (out of 32 kinds investigated). These results show the importance of plant life (especially, filamentary seaweed) in purifying water. (TTT)

5138 BEHAVIOR OF YTTRIUM-91 AND SOME LANTHANONS TOWARDS SERUM PROTEINS IN PAPER ELECTROPHORESIS, DENSITY GRADIENT ELECTROPHORESIS AND GEL FILTRATION. L. Ekman, E. Valmet, and B. Aberg (Royal Veterinary Coll., Stockholm). Intern. J. Appl. Radiation and Isotopes, 12: 32-41(Nov. 1961). (In English)

The radioisotopes of yttrium, cerium, promethium, and ytterbium were administered intravenously as chlorides to rats. The blood serum was collected after 5 and 60 min, respectively. Furthermore these radioisotopes, as chlorides, were added to rat serum in vitro. The binding of the rare earths to the serum proteins was studied by means of paper electrophoresis, free columnar electrophoresis in a sucrose gradient at various pH values, and gel filtration through Sephadex at various pH values. It was found that these elements had already combined with albumins and low-molecular u.v. absorbing complexes in the serum 5 min after injection. No differences were observed between the results obtained when the isotopes were added to serum in vitro or injected intravenously. (auth)

5139 THE GAS EXCHANGE IN THE PROCESS OF RADIUM THERAPY OF PATIENTS WITH PULMONARY CANCER. E. N. Syromyatnikova and E. M. Filkova (State Scientific-Research Inst. of Roentgen-Radiology, Ministry of Health, USSR). Med. Radiol., 6: No. 8, 14-18(Aug. 1961). (In Russian)

Gas exchange was studied before treatment in 30 patients suffering from bronchogenic cancer of the lung and in 11 during the process of radium therapy. In pulmonary cancer the gas exchange is disturbed at rest and during physical loading, especially in patients with an extensive process complicated by metastases. During radium therapy of lung cancer, in the majority of patients with an improvement of the general condition and the roentgenological picture, there is seen an improvement of gas exchange. During physical loading and in the first minutes of rest thereafter the coefficient of oxygen consumption rises with the increase of pulmonary ventilation. At the end of the treatment in a number of patients there is seen a certain deterioration of gas exchange in the development of radium pneumosclerosis. (auth)

5140 INHIBITION OF BONE GROWTH AS A COMPLICATION OF RADIUM THERAPY. K. B. Shimanovskaya (Central Scientific-Research Inst. of Medical Radiology, Ministry of Health, USSR). Med. Radiol., 6: No. 8, 19-23 (Aug. 1961). (In Russian)

Information is given on radiation injuries of the bone and teeth following repeated use of therapeutic doses of radiation in 20 persons: in 19 after treatment of skin angiomas of the face and chest, and in 1 after treating Ewing's sarcoma of the fibular bone. In 10 patients the changes in the bones were coupled with the presence of atrophy, teleangiectasis, and depigmentation of the skin over the changed bone. (auth)

5141 DETERMINATION OF Sr^{90} AND Ca^{45} IN THEIR COMBINED PRESENCE IN BIOLOGICAL SUBSTRATES. V. A. Knizhnikov, P. F. Bugryshev, V. P. Rublevskii, and Yu. M. Nikolaev. Med. Radiol., 6: No. 8, 64-7(Aug. 1961). (In Russian)

A method for the individual determination of Sr^{90} in equilibrium with Y^{90} and Ca^{45}, based on the complete absorption of Ca^{45} beta radiation in an aluminum filter, is given. The accuracy of the method amounts to 15 to 20%. (auth)

5142 PERMEABILITY OF THE MAMMARY GLAND TO SODIUM-24, POTASSIUM-42, CHLORINE-36 AND IODINE-131. P-G. Knutsson (Royal Agricultural Coll., Uppsala). Nature, 192: 977-8(Dec. 9, 1961).

The permeability of the mammary gland to Na^{24}, K^{42}, Cl^{36}, and I^{131} was studied in goats in the first half of lactation. Polyethylene glycol, which does not penetrate the udder epithelium, was used as a reference substance. The injected radioactive solutes were rapidly and fairly evenly distributed throughout the whole milk volume of the injected udder. Data are tabulated on milk concentration at various times after injection. The roles of diffusion and active transport in permeability of the udder are discussed briefly. (C.H.)

5143 RADIATION THERAPY WITH HIGH-ENERGY ELECTRONS. PART I. PHYSICAL CONSIDERATIONS, 10 TO 60 Mev. R. Loevinger, C. J. Karzmark, and M. Weissbluth (Stanford Univ., Calif.). Radiology, 77: 906-27(Dec. 1961).

Physical studies on radiologically important properties of an electron beam are reported. A description is given of the method used for beam monitoring, beam widening by scattering, and field definition by cones and apertures. Large-field central-axis depth-dose curves are given. The effects of back-scatter, small fields, and tissue inhomogeneities are briefly discussed. Methods used for depth-dose measurements are described, with emphasis on the inconsistencies which were observed. Results are given for the absolute dosimetry performed with the ferrous sulfate dosimeter. The intercomparison of central-axis depth-dose curves taken in different materials leads to the concept of an empirical effective density. The advantages and disadvantages of electron therapy at energies above 10 Mev are presented from the physical point of view. (auth)

5144 RADIATION THERAPY WITH HIGH-ENERGY ELECTRONS. PART II. CLINICAL EXPERIENCE, 10 TO 40 Mev. L. M. Zatz, C. F. von Essen, and H. S. Kaplan (Stanford Univ. School of Medicine, Palo Alto, Calif.). Radiology, 77: 928-39(Dec. 1961).

Forty-two lesions were treated with electron beams of energies varying from 10 to 40 Mev. Therapy with large single fields produced brisk skin reactions which were uncomfortable, but which healed within two to four weeks. The late skin changes seemed comparable to those following acute reactions of similar severity produced by 200-kvp x rays. The mucosal reactions corresponded to those produced by similar doses of roentgen rays. It is concluded that electron-beam therapy is a useful tool for the treatment of relatively superficial lesions contiguous to a body surface. This does not require energies exceeding 25 Mev measured at the skin. The use of parallel opposing fields with higher-energy electrons for the treatment of deep lesions probably offers little advantage over present megavoltage x-ray techniques. (auth)

5145 THE METABOLISM OF AN INHALED AND INGESTED SIMULANT OF FALLOUT PRODUCED BY A LAND-BASED NUCLEAR DETONATION. S. H. Cohn, W. B. Lane, J. K. Gong, R. K. Fuller, and W. L. Milne (U. S. Naval Radiological Defense Lab., San Francisco). p.178-91 of "Inhaled Particles and Vapours." New York, Pergamon Press, 1961.

An evaluation was made of the uptake and distribution of fission products deposited internally in mice as a result of exposure to a dry-particle simulant incorporating 2-day-old fission material. The simulant employed was composed of trace amounts of fission product chlorides adsorbed completely on dirt particles in a wide size range. The simulant was generated as airborne particulates and represented, qualitatively, the fall-out which might be encountered as a consequence of a land-based nuclear detonation. The dry-particle simulant was administered both by gavage and inhalation exposure. The internal radiation hazard and the dose to tissues from internally-deposited fission products was calculated. It was shown that, over an extended period, bone would receive the greatest integrated dose due to the uptake of Sr^{90} which has a half-life of 27 years. Following the administration of the simulant by gavage, the initial distribution of activity in the gastrointestinal tract and in the tissues was very similar to that following inhalation exposure. (C.H.)

5146 EXPERIMENTAL CLEARANCE OF URANIUM DUST FROM THE HUMAN BODY. William B. Harris (U. S. Atomic Energy Commission, New York). p.209-20 of "Inhaled Particles and Vapours." New York, Pergamon Press, 1961.

An inhalation experiment was carried out involving approximately 30 mg uranium over 17 inhalation periods during a period of 24 days. From the data which were derived it appears that approximately 60% of the material which was estimated to be inhaled is still retained in the body tissues at the end of the 32nd day. Three curves have been derived showing the rapid urinary elimination during the first 20 hr after inhalation, the slower rate of depletion via the urinary route for the period 20 to 200 hr, and the apparent slow buildup of material in tissues. The curve best representing rapid elimination is given by the equation $\mu g/hr = 0.0145\ d_0 \times 10^{-0.043t}$, where d_0 is initial dose and t is the time in hours. Using the same units, the depletion rate from 20 to 200 hr is best represented by the equation $\mu g/hr = 0.002\ d_0 \times 10^{-0.00028(t-20)}$. The build-up curve is shown by $\mu g/hr = 0.4r\ (1 - 10^{0.0012t})$ where r is the inhalation rate per hour on a 168 hr/week basis. (auth)

Fallout and Ecology

5147 (ARCRL-5) SURVEYS OF RADIOACTIVITY IN HUMAN DIET AND EXPERIMENTAL STUDIES. Report for 1960. (Gt. Brit. Agricultural Research Council. Radiobiological Lab., Grove, Berks, England). Nov. 16, 1961. 88p. (A/AC.82/G/L.701)

Results are presented from a survey of Sr^{90} in human diet in the United Kingdom during 1960. Data are included from a country-wide survey, which enabled the assessment of the mean ratio of Sr^{90} to Ca in the average diet of the population, and local studies in areas where the quantity of Sr^{90} was likely to exceed the average. Measurements were also made of Sr^{90} in herbage and soil from representative pastures throughout the country, and Cs^{137} in milk produced in the United Kingdom during 1960. Results are included from experimental studies of factors affecting the passage of Sr^{90} through food chains. Limited data are also included on Sr^{90} in selected foods from Australia, the Republic of Ireland, and the Federation of Rhodesia and Nyasaland. (C.H.)

5148 (CRER-1000) STRONTIUM-90 AND CESIUM-137 IN CANADIAN WHEAT (1957-1959). W. E. Grummitt (Atomic Energy of Canada Ltd., Chalk River, Ont.) and E. R. Robertson (Canada. Dept. of National Health and Welfare, Ottawa). Nov. 1960. 23p. (A/AC.82/G/L.659)

The concentrations of Sr^{90} and Cs^{137} were measured in Canadian wheat grown in 1957 and 1958 and in wheat exported in 1959. Mean values ranged from 103 to 136 $\mu\mu c$ Sr^{90}/g Ca and from 26 to 46 $\mu\mu c$ Cs^{137}/g K. The ratio of Sr^{90} to Ca in flour was found to be lower than that in whole wheat by a factor of 3.3. (auth)

5149 (TID-14374) ECOLOGICAL DISTRIBUTION OF SOME RODENTS AT THE NEVADA ATOMIC TEST SITE. Donald M. Allred and D. Elden Beck (Brigham Young Univ., Provo, Utah). [1961]. Contract [AT(11-1)-786]. 13p.

Trapping records of rodents of eight species for 16 months in five desert shrub communities at the Nevada Atomic Test Site disclosed: the greatest number of species occurred in the Grayia-Lycium and Coleogyne communities; the fewest were found in the Larrea and Lycium communities; and the total plant cover or average height of plants alone apparently was not directly correlative with species occurrence and animal abundance. Observations were made for correlating total cover and average height to species occurrence and animal abundance, plant composition to animal occurrence, and soil texture to animal species occurrence. (B.O.G.)

5150 (CEA-tr-R-1369) FONDEMENTS ET PROBLEMS DE RADIOECOLOGIE. (Fundamentals and Problems of Radioecology). A. A. Peredelskii (Peredelsky). Translated into French by B. Vinogradoff from Zhur. Obshchei Biol., 18: 17-30(1957). 33p.

Premises are given which are sufficient to have radioecology considered as an independent scientific discipline. The term radioecology includes a synthesis of radiological, radiogeochemical, and radiobiological problems. (J.S.R.)

5151 (CEA-tr-R-1423) RADIOACTIVITE NATURELLE DES ORGANISMES MARINS. (Natural Radioactivity of Marine Organisms). A. F. Fedorov. Translated into French from Priroda, 48: No. 4, 86-8(1959). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 22258.

5152 RADIOACTIVE CONTAMINATION OF SOILS AND PLANTS BY FISSION PRODUCTS. Luis Mellado Brauns. Bol. del. inst. nacl. invest. agron. (Madrid), 20: No. 43, 259-85(Dec. 1960). (In Spanish)

Research work on the agricultural aspects of contamination, arising from the use of nuclear energy, is reviewed and summarized. Factors governing local and worldwide distribution and deposition of fission products are examined. Fission products, once deposited, contaminate soils and plants; the latter absorb those products either directly (floral, foliar and stem-base absorption) or indirectly (root absorption from a contaminated soil). Milk may be contaminated if grazing animals feed on radioactive pastures. Factors influencing all these processes are studied, namely: properties of fission products, their distribution in soils and plants, soil properties and plant anatomy and physiology. The need of preventive measures, to safeguard food from contamination is emphasized. (auth)

Radiation Effects on Living Tissues

Refer also to abstract 5257

5153 (A/AC.82/G/L.654) CHRONIC OCCUPATIONAL EXPOSURE TO ^{90}Sr AND ^{226}Ra. Preliminary Report. Jan Mueller, Alois David, Marie Rejsková, and Dagmar Březiková (Karlova Universita, Prague). Nov. 1, 1961. 14p.

The follow-up of 103 workers employed in the luminizing industry who worked for different periods of time with a paint containing up to 1.2 mc of Sr^{90} per gram is covered. Out of this group 34 were selected for a more detailed clinical investigation. In most cases only the latter part of the urinary Sr^{90} excretion curve could be followed. In one case of new contamination, the urinary Sr^{90} excretion curve fitted the equation $E = 0.376 \exp[-(0.693t/1.7)] + 0.119 \exp[-(0.693t/4.4)] + 0.004 \exp[-(0.693t/50)]$. The body burden of Sr^{90} was estimated to be of the order of units up to tens of microcuries. The body burden of Ra^{226} was of the order of 10^{-8} g or less. From the hematological point of view the most interesting findings were signs of irritation of erythropoiesis such as reticulocytosis and hyperplasis of the erythroblast series in the bone marrow. (auth)

5154 (A/AC.82/G/L.666) COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION ON MAN, DETAILED ANNUAL REPORT NO. 2. (United Arab Republic. Atomic Energy Establishment, Inshas, Egypt). July 1961. 48p.

Studies were made of radiation levels, especially those due to radioactive dust, in phosphate mines on the Red Sea Coast. In a study of the hazards from diagnostic radiology, 100 cases of benign lesions were chosen for treatment with superficial radiotherapy and to assess the weighed average gonad dose. Observations made on the radioactive content of air and the deposition of radioactivity on the ground at selected sites in the United Arab Republic during the period January 1960 to February 1961 are reported. (M.C.G.)

5155 (CNB-20) CONFRONTO FRA GLI EFFETTI DEI RAGGI X, DEI RAGGI γ DEL COBALTO-60 E DEGLI ELETTRONI VELOCI PRODOTTI DAL BETATRONE. INFLUENZA DEI PROCESSI DI RIPARAZIONE. (Comparison between the Effects of X rays, γ Rays of Cobalt-60 and Fast Electrons Produced by the Betatron. Influence of the Recovery Processes). C. Biagini, P. F. Marchi, P. G. Paleani-Vettori, G. Silini, and R. Zito (Italy. Comitato Nazionale per l'Energia Nucleare. Division di Biologia e di Protezione Sanitaria, Rome). Sept. 1960. 101p.

The comparative effects of 150-kvm x radiation, Co^{60} gamma rays (1.17 to 1.33 Mev), and 6 and 15 Mev electrons on the recovery process of mice and rats exposed to these radiations were studied. The parameters studied were total body weight, weight of the most sensitive organs (thymus, spleen, intestines, and gonads), and Fe^{59} uptake by the red blood cells. The materials and techniques used are explained in detail. The experimental results showed that the change in body weight between the various groups, even when the analysis was prolonged to 60 days, had no significant difference. The study of the weight change in the radiosensitive organs permitted three successive phases to be distinguished: rapid decrease of the weight, rapid increase of the weight after the maximum decrease, and a phase of continuous weight increase but with less slope than the preceding phase. A difference between the x rays and the other radiations is observed slightly in the first phase, to a great degree in the second, and scarcely at all in the third phase. In general a slight variation is detected between the effects of the high energy radiations, but no significant difference. A diversity of behavior was detected between radiosensitive tissue and less sensitive tissue in irradiation with x rays and with high energy radiation. (J.S.R.)

5156 (COO-224) RESEARCH IN RADIOBIOLOGY. Semi-annual Report of Work in Progress on the Chronic Toxicity Program. Thomas F. Dougherty (Utah. Univ., Salt Lake City. Coll. of Medicine). Sept. 30, 1961. Contract AT(11-1)-119. 104p.

Injection tables are presented giving the history of dogs (dose to skeleton, cause of death, etc.) injected with Ra^{226}, Pu^{239}, Th^{228}, Sr^{90}, and $Ca^{45} + Sr^{85}$. The rate of tooth loss in beagles injected with Ra^{226}, Ra^{228}, and Pu^{239} was found to increase with successively higher injected doses above a certain dose minimum. The effects of Th^{228} and Ra^{226} injected into dogs on the chemical constituents of blood were measured and compared with results for other radionuclides. A preliminary statistical analysis is presented on radiation effects data on hematological properties. The reevaluation of Sr^{90} injection standards, including the checking of counting tube dimensions, is described. Analytical methods are presented for determining small amounts of Sr^{90} and Th^{228} in excreta and other biological materials. Data are presented for the retention of Sr^{90} in beagles up to 2300 days after injection and of Pb^{212} in Th^{228}-injected beagles up to >2700 days after Th^{228} injection. Experiments on the growth modifications of tumors (Sarcoma 180 and lymphosarcoma) in mice by electric current are reported. (D.L.C.)

5157 (TID-14212) RADIATION INDUCED VIABILITY MUTATIONS IN THE HONEY BEE. Progress Report [for 1961] and Renewal Proposal of Contract for 1962. William R. Lee (New Hampshire. Univ., Durham). Contract AT(30-1)-2315. 6p.

The spectrum of viability mutations ranging from dominant lethals to detrimentals in haploids that resulted from irradiating semen from a single haploid male was studied in the honey bee. From the decrease in viability of diploid progeny following irradiation of the spermatheca of the parental queen, it was calculated that one or more dominant lethals were induced in 60.8% of the sperm cells. In a separate test using the same dosage on an unrelated queen 60.9% dominant lethals were found. Recessive mutations and mutants with incomplete dominance were detected in haploid progeny of F-1 queens. (M.C.G.)

5158 (TID-14316) TECHNICAL PROGRESS REPORT [ON RADIOBIOLOGY]. Period [covered]: February 1, 1961–October 31, 1961. A. B. Burdick (Purdue Research Foundation, Lafayette, Ind.). Oct. 31, 1961. Contract AT(11-1)-856. 5p.

Studies are being made of radiation protection in seeds associated with partial hydration. It was found that a portion of this protection is attributable to a post-irradiation condition of partial hydration; partially hydrated seeds are not fully protected if they are dried rapidly after irradiation. It was observed that seeds are fully protected if they are brought to a condition of partial hydration and kept there for two days in equilibrium with a partially saturated atmosphere at 3°C and then irradiated. Studies were begun of "specific loci" mutation of sensitive and protected four-gene-heterozygous seed. The somatically protected group gave about the same number of "gene" mutations at 30,000 r as the sensitive group gave at 7,500 r. Free amino acid studies were made of a series of radioinduced chlorophyll deficient mutants. Three mutants among the 14 studied were conspicuously low in total chlorophyll. They were also found to have more free glutamic acid in the leaves than wild-type. (M.C.G.)

5159 (TID-14463) THE INVESTIGATION OF THE GENETIC STRUCTURE OF POPULATIONS. [Period covered]: October 1, 1960–October 31, 1961. Bruce Wallace (New York State Coll. of Agriculture, Ithaca). Nov. 30, 1961. Contract AT-(30-1)-2139. 15p.

The viability effects of newly induced second-chromosome mutations are expressed in heterozygous condition. There appears to be very little effect. One interesting point is that: the regression of viability on radiation exposure has consistently been positive for flies homozygous for entire second chromosomes while it has been negative for flies carrying two different chromosomes from the same population. At one time, this difference bordered on statistical significance. An analysis of data obtained from Dobzhansky is described which is believed to prove the existence of over-dominance. In brief, if over-dominance does not exist, the viability of homozygous and heterozygous individuals should converge on a common point at the upper end of the viability distribution. In contrast to this expectation, the viabilities of homozygotes and heterozygotes diverge in the region of high viabilities. New work on the study of inversions and deficiencies is also described. (auth)

5160 (JPRS-11242) MEDICAL RADIOLOGY. Translation of Med. Radiol., 6: No. 3, 3-94(Mar. 1961). 190p.

A translation of Meditsinskaya Radiologiya (Medical Radiology) Vol. 6, No. 3, March 1961, Moscow, pp 3 to 94 is presented. Separate abstracts were prepared for 17 of the papers. The remaining 4 were previously abstracted for NSA. (M.C.G.)

5161 (JPRS-11242(p.4-15)) FUNCTIONAL CHANGES IN PATIENTS WITH POLYCYTHEMIA DURING TREATMENT WITH RADIOACTIVE PHOSPHORUS. V. V. Shishkina. Translated from Med. Radiol., 6: No. 3, 3-7 (Mar. 1961).

Investigations were made on the volume of the circulating blood and erythrocytes, the intensity of the capillary-tissue metabolism and the permeability of erythrocytes for radiophosphorus in patients with Polycythemia vera before and after treatment with P^{32}. There were revealed changes of the referred-to indices, which depended upon the severity of the clinical course and on the effect of treatment. (auth)

5162 (JPRS-11242(p.16-24)) EXPERIENCE IN THE USE OF STRYCHNINE FOR THE PREVENTION OF RADIATION SICKNESS IN RADIATION THERAPY. P. M. Leonov. Translated from Med. Radiol., 6: No. 3, 7-11 (Mar. 1961).

The influence of strychnine nitrate on the time of appearance and markedness of radiation sickness symptoms in 125 patients suffering from cancer of female genitalia, treated by the combined radium method was investigated. 115 analogous patients were not given strychnine. One ml of a 0.1% strychnine solution was introduced subcutaneously over two days throughout the course of radium therapy. Up to 20 ml of the solution was administered to the majority of cases. In the group of patients receiving strychnine there was noted a lesser frequency of appearance of such radiation sickness symptoms as vomiting, nausea, loss of appetite and appearance or intensification of general weakness. Besides, leukopenia and lymhopenia were marked to a lesser degree. Strychnine nitrate could be utilized along with other agents for the prevention of forced interruptions in the treatment, especially when there is a necessity of using large doses of ionizing radiation. (auth)

5163 (JPRS-11242(p.25-31)) THE PROPHYLACTIC USE OF CYSTEINAMINE AND CYSTAMINE IN ACUTE RADIATION SICKNESS. V. A. Razorenova and E. (Ye.) N. Shcherbova. Translated from Med. Radiol., 6: No. 3, 11-14(Mar. 1961).

Experimental data concerning the prophylactic effect of cysteinamine and cystamine in acute radiation sickness are reported. (auth)

5164 (JPRS-11242(p.32-8)) THE PREVENTION OF RADIATION SICKNESS IN THE MOTHER AND IN THE INTRAUTERINE FETUS. A. P. Kiryushchenkov. Translated from Med. Radiol., 6: No. 3, 14-17(Mar. 1961).

Data are presented on the employment of a sulfur-containing preparation (propamine) for the prevention of radiation sickness in the mother and intrauterine fetus. Rats were irradiated on the 15th day of gestation with roentgen rays in a dose of 300 r. Propamine was introduced intraperitoneally 15 minutes before the irradiation (75 mg/kg). As the result of the use of propamine, there was an earlier regeneration of white and red blood of the irradiated rats, an elevated survival rate, and normalization of processes of growth and development of the progeny. (auth)

5165 (JPRS-11242(p.39-47)) THE STATE OF THE HEMATO-ENCEPHALIC BARRIER AND OF CERTAIN OTHER HISTO-HEMATIC BARRIERS IN THE OFFSPRING OF ANIMALS HAVING EXPERIENCED ACUTE RADIATION SICKNESS. V. A. Tats'evskii (Tatsiyevskiy). Translated from Med. Radiol., 6: No. 3, 17-21(Mar. 1961).

Investigations are described pertaining to the condition of the hemato-encephalic barrier and certain other histo-hematic barriers in the progeny of animals who had sustained acute radiation sickness. (auth)

5166 (JPRS-11242(p.48-60)) PECULIARITIES IN THE COURSE OF ACUTE RADIATION SICKNESS IN YOUNG RATS. V. V. Kholin. Translated from Med. Radiol., 6: No. 3, 21-6(Mar. 1961).

Studies were made of the specific features in the course of acute radiation sickness in rats, aged 9 to 10 days. There were found essential peculiarities of the reaction of rats, aged 9 to 10 days, to the action of roentgen rays in doses ranging from 500 to 50,000 r. With the increase of the dose the age differences in the reaction to irradiation became obliterated; in a dose of 50,000 r they were least marked. (auth)

5167 (JPRS-11242(p.61-9)) ELECTROCARDIOGRAPHIC CHANGES IN RABBITS IN ACUTE RADIATION SICKNESS CAUSED BY IRRADIATION WITH A 25 MEV BETATRON. V. P. Polkovnikova. Translated from Med. Radiol., 6: No. 3, 26-30(Mar. 1961).

Data are presented of electrocardiographic investigations staged on rabbits with acute radiation sickness provoked by single irradiation with non-filtered rays of betatron 25 Mev. The changes were manifested in acceleration of the cardiac rhythm, appearance of extrasystoles and blocks of the left branch of the atrioventricular bundle (bundle of His). (auth)

5168 (JPRS-11242(p.70-81)) THE MECHANISM OF REDUCTION OF THE PROPERDIN LEVEL IN THE BLOOD IN ACUTE RADIATION SICKNESS. I. L. Chertkov and Z. I. Sheremet. Translated from Med. Radiol., 6: No. 3, 30-5(Mar. 1961).

It was found that diminution of the properdin system activity during acute radiation sickness in different animals is regularly attended by an increase in the content of blood mucopolysaccharides at the same period of time. The mechanism of properdin reduction in acute radiation sickness consists in the binding of properdin by mucopolysaccharides released from the tissues. This mechanism is relatively specific for acute radiation sickness. (auth)

5169 (JPRS-11242(p.82-90)) THE ROLE OF THE PROPERDIN SYSTEM AS A NON-SPECIFIC FACTOR IN THE RESISTANCE OF THE ORGANISM TO THE ACTION OF IONIZING RADIATION. P. I. Remezov and S. D. Yakovleva. Translated from Med. Radiol., 6: No. 3, 35-9(Mar. 1961).

The dynamics of the properdin level in white mice during a single action on the organism of various doses of ionizing radiation and the ability of the organism to restore this protective function were studied. Investigation of the properdin level in chronic effect of low doses of ionizing radiation was carried out. It was established that by stimulating the nonspecific protective mechanisms of the organism (the properdin system) one could essentially augment the body's resistance to irradiation. (auth)

5170 (JPRS-11242(p.91-9)) THE CYTOCHEMISTRY OF PHOSPHATASES, OXIDASES, AND PEROXIDASES IN THE ELEMENTS OF THE HEMATOPOIETIC TISSUES IN RADIATION AFFECTIONS. E. I. Terent'eva (Terent'yeva) and L. I. Kazanova. Translated from Med. Radiol., 6: No. 3, 39-43(Mar. 1961).

Investigations were effected of the influence of ionizing radiation on the content of peroxidase, oxidase, and phosphatase in the blood cells and bone marrow of dogs and monkeys. It was observed that in acute radiation sickness there is a considerable reduction in the quantity of enzymes in the elements of hematopoiesis. Restoration of the fermentative activity of cells occurred at different periods following irradiation; in some cases it is associated with the treatment employed (oxidative enzymes), while in other (phosphatases)—it occurred irrespective of the treatment. (auth)

5171 (JPRS-11242(p.100-9)) THE INFLUENCE OF SCREENING AND OF INJECTIONS OF BONE MARROW CELLS ON THE EFFECTIVENESS OF SEROPROPHYLAXIS AGAINST DIPHTHERIA TOXICITY IN IRRADIATED ANIMALS. D. R. Kaulen. Translated from Med. Radiol., 6: No. 3, 43-7(Mar. 1961).

An attempt was made to augment the effect of seroprophylaxis of diphtheritic intoxication in the irradiated guinea pigs by means of screening the region of the spleen or haunches of the animals during the irradiation, or by introduction of homologous bone marrow to the irradiated animals. The results of the investigations disclosed that screening increased twofold the effectiveness of seroprophylaxis. The treatment of the irradiated animals with homologous bone marrow also evaluated two- or threefold the efficacy of seroprophylaxis in comparison with the nontreated animals. (auth)

5172 (JPRS-11242(p.110-14)) STUDIES OF THE CHANGES IN THE INTESTINAL MICROFLORA IN EXPERIMENTAL RADIATION SICKNESS. Yu. S. Varenko. Translated from Med. Radiol., 6: No. 3, 48-50(Mar. 1961).

Certain problems were studied pertinent to qualitative shifts in the normal coli flora. There were observed marked changes in the antagonistic function of B. coli in respect to Bacterium dysenteriae and Staphylococcus. The quantity of hemolytic strains of B. coli did not rise in mice subjected to irradiation in a dose of 500 r. (auth)

5173 (JPRS-11242(p.115-19)) THE COURSE OF EXPERIMENTAL CANDIDIASIS (MONILIASIS) OF THE LUNGS FOLLOWING X-IRRADIATION. A. V. Tsinzerling. Translated from Med. Radiol., 6: No. 3, 51-4(Mar. 1961).

In x-irradiated white rats (450 r) experimental moniliasis of the lungs, induced by intranasal administration of 500 mln cells of Candida albicans, ran a considerably severer course. The lethality rate was higher (1:2.9) than in the non-irradiated animals (death rate 1:11.3). The varying course of the infection was due apparently to weakening of the local leukocytic reaction following irradiation. This was conducive to multiplication of the fungi and to a more prolonged viability. A generalized infection was observed more often as a result of insufficient restriction of foci in the lungs. (auth)

5174 (JPRS-11242(p.120-5)) LONG-TERM SEQUELAE OF Po^{210} INJURY. S. M. Mikhailovich (Mikhaylovich) and E. (Ye.) V. Erleksova. Translated from Med. Radiol., 6: No. 3, 54-8(Mar. 1961).

The results of investigations concerning the remote sequelae of polonium affection caused by peroral administration of 0.25 mc/kg of Po^{210} to dogs. (auth)

5175 (JPRS-11242(p.126-34)) MINERAL AND PROTEIN METABOLISM IN BONE TISSUES OF RATS IN PLUTONIUM INJURY. N. I. Elkina (Yelkina) and I. A. Tseveleva. Translated from Med. Radiol., 6: No. 3, 58-63 (Mar. 1961).

Investigations concerning the mineral and nitrogen metabolism in the bone tissue of rats at different periods following the administration of plutonium in quantities provoking a subacute and chronic affection are discussed. Essential differences were divulged in the metabolic processes of the diaphyseal and epiphyseal portions of the bones. The intensity of inclusion of P^{32}, Ca^{45}, and glycine-1-C^{14} in the epiphyseal portion of bones of the experimental animals was considerably lower than in the controls. (auth)

5176 (JPRS-11242(p.135-41)) INCREASE IN THE SENSITIVITY OF COUNTING DEVICES WITH HORIZONTAL LEAD CHAMBERS FOR MEASURING PREPARATIONS OF LOW ACTIVITY. N. A. Troitskii (Troitskiy). Translated from Med. Radiol., 6: No. 3, 64-71(Mar. 1961).

A highly sensitive calculating apparatus made from serial parts widely used in medical institutions is discussed. The device and the technique of measuring preparations are described. (auth)

5177 (JPRS-11242(p.142-6)) THE USE OF ADDITIONAL EXTERNAL PACKING IN THE TRANSPORTATION OF RADIOACTIVE PREPARATIONS. Z. S. Aref'eva (Aref'yeva), V. V. Bochkarev, L. M. Mikhailov (Mikhaylov), and L. V. Timofeev (Timofeyev). Translated from Med. Radiol., 6: No. 3, 68-71(Mar. 1961).

Studies were made of the ways of reducing the weight of lead containers and standardization of sizes of additional external packages for radioactive preparations. (auth)

5178 ABSORPTION FROM GASTROINTESTINAL TRACT OF THE RAT AFTER X-IRRADIATION. Maurice F. Sullivan (General Electric Co., Richland, Wash.). Am. J. Physiol., 192: 1013-16(Dec. 1961).

An in situ perfusion method was used to measure glucose absorption from the x-irradiated or nitrogen-mustard-treated rat. Inhibition was greatest 3 days after treatment and recovery had begun by the 6th day. The effect on absorption was not appreciably different after 900 r than after 1,500 r, although histologic damage was much greater after the higher dose. Pretreatment with cysteine or AET prevented the decreased absorption after 900 r but did not protect against 1,500 r nor against the effect of HN_2. The absorption of d(+)-xylose was also decreased 3 days after irradiation of the intestine. Thus, both active and passive transport mechanisms involved in sugar absorption were decreased by irradiation of the intestine. The absorption of fat, on the other hand, was not decreased as a result of direct action by x-radiation on the intestinal epithelium, since oleic acid absorption was unaffected by exposure of the intestine to radiation. (auth)

5179 IRON 59 INCORPORATION INTO ERYTHROCYTES OF HAMSTERS AFTER IRRADIATION. W. Lohmann, J. L. Glasgow, and W. H. Perkins (Univ. of Arkansas, Little Rock and Consolidated Veterans Administration Hospital, Little Rock, Arkansas). Am. J. Physiol., 192: 1134-6(Dec. 1961).

The effect of 800 r of whole-body Co^{60}-γ and x irradiation on the incorporation of citrate-Fe^{59} into erythrocytes of male hamsters was investigated. Iron-59 was given intraperitoneally immediately postirradiation, and serial blood samples were obtained. The nonirradiated control animals showed a progressive increase in the Fe^{59} activity of the erythrocytes, reaching a maximum in 4 to 5 days. After a 5-day plateau, the activity gradually decreased. The Fe^{59} activity of the irradiated animals decreased, initially, then increased gradually. After 7 days the incorporation rate of Fe^{59} was 27% by the x irradiated and 22% by the Co^{60}-γ-irradiated animals, using the controls as 100% values. Ten days later the incorporation rate was 40% by the x-irradiated animals. None of the Co^{60}-γ-irradiated animals survived 10 days, but all of the x-irradiated animals survived. In the x-irradiated animals, the leukocyte counts rose, initially, then decreased and returned, gradually, to preirradiation levels after 30 days. The specific Fe^{59} activity of different organs of irradiated and control hamsters is reported. (auth)

5180 EFFECTS OF X-RAY IRRADIATION IN ASCITES TUMOR CELLS: PARTIAL RESTORATION OF DPN CONTENT AND DNA SYNTHESIS BY NICOTINAMIDE. H. Hilz, M. v. Gossler, M. Oldekop, and M. Scholz (Universität, Hamburg). Biochem. Biophys. Research Commun., 6: 379-84(Dec. 20, 1961).

An apparent relationship is reported between desoxynuclear protein content and thymidine incorporation into desoxyribonucleic acid of Ehrlich ascites tumor cells. The effects of x radiation and nicotinamide on the synthesis of desoxyribonucleic acid are described. (C.H.)

5181 EFFECTS OF RADIOPHOSPHORUS ON RYE PLANTS. Matilde Martinez Vazquez and Francisco M. Sarasola Sancho. Bol. del inst. nacl. invest. agron.(Madrid), 20: No. 43, 287-309(Dec. 1960). (In Spanish)

The effects of P^{32} on rye plants have produced in their descendants (F_2) the following anomalies: minor vegetative development in the plant in all their stages, but major precocity; kernels not well appointed, but of interesting proteic value; ears very ramified, with more kernels than the normal rye, but with little fertility taking into consideration the big number of spikelets caused by their ramification; minor germinative faculty that the normal rye, very apparent in the country; a big inhibition in the development of the first lateral roots pairs; total inhibition in the development of the roots, belonging to the two lateral pairs placed nearest to the hypocotyl region; embryos with light of full torsion scutellum and coleoptyl can have origine for effect of the pressure suffered in the ovary since the space with which the fecundate ovules counts in the development will be reduced by the big density of the spikelets and so of flowers which show in the stalks secondary, tertiary etc. of the ramified ears; twin embryos with free, coleoptyls and embryos with double hypocotyl buds wrapped with one coleoptyl; big abnormality in the arrangement of the vascular system in the hypocotyl region of certain embryos, in order to determine it, in the scutellum vessels through coleoptyl, in embryos which show all their organs perfectly normal, without any deformation or torsion. These two anomalies lastly mentioned will be able to attribute to genetic causes; a big recuperation can be confirmed of the cells and almost the disapparition of the anomalies found in mitosis in plants with treatments; and in meiosis it has followed some citological alterations like the apparition of anafasics bridges, later chromosomes and supernumerarys, but in very little number. (auth)

5182 THE EFFECTS OF IONIZING RADIATION ON PLANTS. Cesar Gomez Campo. Bol. del inst. nacl. invest. agron. (Madrid), 21: No. 44, 129-67(June 1961). (In Spanish)

A summary is presented of the effects of ionizing radiations on plants on five different levels as follows: Physical Level: ionization or excitation of molecules; Chemical Level: free radicals, their origin and action; Cell Level: cytological, genetical or physiological changes induced within the cell; Plant Level: changes appearing in the plant as a consequence of the effects at the cell level; and Population Level: response of the new types to natural or artificial selection pressures. A number of factors which could influence the results of a radiation treatment, are described: Type of Radiation: alpha, beta, gamma, and x rays, protons, neutrons, and ionization density; Radiation Dose: total dose, dose rate, acute and chronic exposures, dose fractionation; Plant Material: genotype, nuclear volume, degree of poliploidy, chromosome number (in diploids) duration of nuclear cycle, and part of the plant; Moment of Irradiation: stage of plant cycle, stage of nuclear cycle, age of tissue, and storage effect; and Treatment Conditions: temperature, other radiations, water content, oxygen, chemicals. (auth)

5183 UV MICROBEAM IRRADIATION OF CHROMOSOMES DURING MITOSIS IN ENDOSPERM. A. Bajer and J. Molè-Bajer (Univ. of Chicago). Exptl. Cell Research, 25: 251-67(Nov. 1961).

Using endosperm of Haemanthus katharinae as material, some hundred kinetochores and chromosome arms in different stages of mitosis were irradiated with heterochromatic UV microbeams 2 and 4 μ in diameter. It was found that, if the dose is high enough, a pale spot appears and is followed by a sticky bridge in the irradiated place during anaphase. The pale spot shows a tendency to swell and spread. In experiments with much higher doses, effects on the whole cell, such as formation of restitution nuclei, very irregular anaphases, death of cell, were obtained. Chromosomes with kinetochores irradiated during prophase, prometaphase and metaphase do not show any striking difference in respect to their movements as compared to non-irradiated ones, until the anaphase begins. In anaphase they have a tendency to occupy the equatorial position until formation of the phragmoplast. Normal activity of previously irradiated kinetochores is also proved by the way they are stretched during prometaphase and anaphase. Chromosomes with kinetochores irradiated during anaphase change their normal behavior and show some features of prometaphase chromosomes, e.g., they have a strong tendency to move toward the equatorial position. Some explanations of chromosome behavior after irradiation have been suggested. (auth)

5184 EFFECT OF LOW LEVEL X-IRRADIATION ON THE FERTILIZED EGG OF THE MAMMAL. R. Rugh and Erica Grupp (Columbia Univ., New York). Exptl. Cell Research, 25: 302-10(Nov. 1961).

Pregnant mice were exposed to x rays so that 5 r were absorbed by the embryos 0.5 days after conception. Entire oviducts and uteri were searched at 6 and at 24 hr for very early embryos. Even at this low level of exposure the first cleavage was delayed and there was an increase from 2.5% in the controls to 20% in the number of abnormals, among the irradiated. The anomalies included cytoplasmic damage appearing as a wave of necrosis over the egg, hyperchromaticity of both cytoplasm and nucleus, exudation of cytoplasm through ruptured cell membranes, pyknosis of nuclei and congealing (sticky) chromosomes, and complete dissolution of blastomers with only the polar body remaining. These anomalies are rarely, if ever, found in the controls. On the basis of this and other recent studies it is believed that the newly fertilized egg is probably the most radiosensitive cell in the mouse, except possibly the germ cells. (auth)

5185 EFFECTS OF CHRONIC GAMMA IRRADIATION ON THE GENERATION CYCLE OF THE MOUSE DUODENUM. S. Lesher, R. J. M. Fry, and G. A. Sacher (Argonne National Lab., Ill.). Exptl. Cell Research, 25: 398-404 (Nov. 1961).

The generation time of the duodenal crypt cells of BCF$_1$ mice exposed to 12 r per day gamma irradiation for 200 days starting at 100 days of age was compared to that of 300-day-old nonirradiated controls using tritiated thymidine. It was found that the generation time was approximately 12 hr in the irradiated group compared with approximately 15 hr in the control group. The results suggest that the difference in generation times is due to differences in the duration of S and or G$_1$ stages. The number of crypt cells initially labeled after the injection of tritiated thymidine was less by about 2 cells per crypt in the irradiated mice. The interanimal variation was less in the irradiated group and was similar to that found in young CAF$_1$ mice (93 days of age). (auth)

5186 EFFECT OF RADIATIONS ON BIOLOGICAL SYSTEMS: BIOCHEMICAL EQUILIBRIA. P.-E. Pilet (Université, Lausanne, Switzerland). Inds. atomiques, 5: No. 7-8, 53-5(1961). (In French)

X and α radiations have a considerable effect on living tissues, their constituents, and their behavior. The role played by ionizing radiation (particularly α and x radiation) on biological systems is analyzed. In the first part of the study the effect of radiation on biological equilibrium is examined. The equilibria considered are secondary reactions, carbon compounds, nitrogen compounds, and symplexes. (J.S.R.)

5187 THE CHARACTERISTICS OF THE ANTIRADIATION EFFECT OF VITAMIN B_6 IN ACUTE EXPERIMENTAL RADIATION INJURY. E. G. Dolgov (Semipalatinsk School of Medicine, USSR). Med. Radiol., 6: No. 8, 32-6(Aug. 1961). (In Russian)

Studies were made on the tissue permeability of albino rats for vital stains at different terms following gamma irradiation in doses of 400 and 800 r. After the irradiation an increase is noted in the staining capacity of some tissues, this being due apparently to the appearance in the organism of irradiated animals of denaturizational changes of protein structures of cells. The use of vitamin B_6 after irradiation produces a favorable effect on the shifts of sorptive properties of tissues in experimental animals. (auth)

5188 FUNCTIONAL AND MORPHOLOGICAL CHANGES OF THE LYMPHATIC SYSTEM IN SECONDARY CHRONIC RADIATION SICKNESS. A. N. Kishkovskii (Kirov Military Medical Academy of the Order of Lenin, USSR). Med. Radiol., 6: No. 8, 41-5(Aug. 1961). (In Russian)

Experiments were staged on rabbits. It was found that in secondary chronic radiation sickness the resorption capacity of the lymphatic system becomes impaired, the tone of lymphatic vessels and the permeability of their walls change, and the lymph circulation as well as the filtrational function of the lymph nodes and permeability of their capsule become disturbed. These changes are of a phasic nature. The duration and degree of markedness of the above changes depend upon the severity of the clinical course of the disease. (auth)

5189 THE STATE OF THE CORTICAL FUNCTION OF THE ADRENALS IN CHRONIC ACTION OF IONIZING RADIATION. N. L. Kanner (State Scientific-Research Inst. of Industrial Hygiene and Occupational Sickness, USSR). Med. Radiol., 6: No. 8, 45-51(Aug. 1961). (In Russian)

Studies were made on the adrenal function in persons subjected to the constant action of low doses of ionizing radiation, as well as in patients affected with a chronic form of radiation sickness. Subject to assessment was the content of 17-oxicorticosteroids and eosinophils in the peripheral blood following ACTH loading. It was found that the initial level of corticosteroids in the persons examined does not differ from normal values. The increase of corticosteroids after ACTH stimulation in persons constantly in contact with sources of ionizing radiation is considerably lower than normal values. In the progress of chronic radiation sickness, the increase approaches normal indices. After ACTH loading the content of eosinophils in those examined tends to decrease similarly as in healthy subjects. (auth)

5190 EARLY CHANGES OF THE CARBOHYDRATE–PHOSPHORUS METABOLISM IN ACUTE RADIATION LESIONS AND THEIR PATHOGENETIC IMPORTANCE. D. A. Golubentsev. Med. Radiol., 6: No. 8, 51-6(Aug. 1961). (In Russian)

Immediately after the action of lethal doses of ionizing radiation there could be found almost no general disturbances of carbohydrate–phosphorus metabolism. This could have been the cause of rapid and profound impairments of the vital activity of the organism. (auth)

5191 THE INITIAL MANIFESTATIONS OF THE AFFECTION IN DOGS SUBJECTED TO DAILY INTRODUCTION OF Sr^{90}. O. G. Alekseeva, E. N. Klimova, V. I. Korchemkin, and I. K. Petrovich. Med. Radiol., 6: No. 8, 57-64 (Aug. 1961). (In Russian)

Investigations were conducted on 4 dogs subjected to daily enteral administration of Sr^{90} in a concentration of 0.02 μc/kg for a period of $2\frac{1}{2}-3$ years, comprising a tissue dose in the skeleton of 230 – 350 rad. During this period of time, no perceptible clinical symptoms of the affection were found. However, upon detailed study of the organism's reactivity clearly pronounced functional changes of the nervous and cardiovascular systems, as well as of the natural immunity and hematopoiesis were established. (auth)

5192 NEW DATA CONCERNING THE ACTION OF IONIZING RADIATION ON ANTIBODY FORMATION. R. V. Petrov. Med. Radiol., 6: No. 8, 68-71(Aug. 1961). (In Russian)

A review is given of the effects of ionizing radiation on antibody formation, and it is shown that radiation does not completely depress the formation processes. Moreover, the depressive action depends on the type of antigens used in immunization. Repeated or multiple antigen injections following irradiation reduce the depressing effects. (R.V.J.)

5193 THE IMPORTANCE OF THE DEPOSITING SUBSTANCE FOR THE FORMATION OF PERFRINGENS ANTITOXIN DURING TOTAL IRRADIATION. L. G. Kovtunovich. Med. Radiol., 6: No. 8, 72-6(Aug. 1961). (In Russian)

Tests on 67 guinea pigs immunized with single or double doses (at 10 day interval) of perfringens pattern antitoxin and re-vaccinated after 4 months showed that depositing substances increase the immunizing effects of perfringens pattern antitoxin during irradiation, and the type and quality of the antigens used determined the ability to develop antitoxicity during total-body exposure. (R.V.J.)

5194 THE INFLUENCE OF X-RAYS ON THE AGGLUTINATION REACTION IN ANIMALS VACCINATED AGAINST BRUCELLOSIS. V. M. Zhidovtsev. Med. Radiol., 6: No. 8, 77(Aug. 1961). (In Russian)

Tests on rabbits immunized with dry, live brucellosis vaccine and irradiated with 100, 200, and 400 r at the height of agglutination showed a drop in agglutin titer with increased x-ray dose. The higher the dose the faster is the drop in agglutin. (R.V.J.)

5195 PNEUMONIA OF RATS PROVOKED BY COOLING 5 MONTHS AFTER X-RAY IRRADIATION. L. N. Lavrent'ev. Med. Radiol., 6: No. 8, 77-8(Aug. 1961). (In Russian)

Exposure to low room temperatures provoked pneumonia and subsequent death in 21 of 42 male white rats that, 5 months prior to the experiment, suffered from radiation sickness induced by 400 r. The 21 control rats did not contract pneumonia and did not show any bad after effects. Microscopic studies showed pathological changes in the lung tissues while the lung tissues in control rats did not exhibit any changes. (R.V.J.)

5196 INCREASE IN THE DENSE CYTOPLASMIC BODIES IN RADIATION-INDUCED GIANT CELLS OF THE CULTURED FIBROBLAST. A. F. Hayward (Univ. of Glasgow). Nature, 192: 891-2(Dec. 2, 1961).

In giant cells developed from fibroblasts after irradiation, the nucleus is large and convoluted so that thin sections often give an impression of multi-nucleation. Individually the cytoplasmic structures are identical with those of the non-irradiated cells, though the Golgi apparatus may appear more diffuse. The striking feature of these cells is the increase in the number of the dense bodies, which occur in groups of 12 to 15 in each cell in the thin sections. As in the normal cell, they are approximately 0.5 mμ in diameter, with a smooth outer membrane and opaque ground substance. Their internal structure is more variable, most have some lamellations, and myeloid bodies are fairly common. After Thorotrast treatment for 1 hr, the dense bodies of the giant cells show a considerable concentration of granules. It is concluded that, as a result of continuous pinocytosis, when cell division in cultured fibroblasts is prevented by radiation, the dense cytoplasmic bodies increase in number. (P.C.H.)

5197 ACTION OF RADIATION ON SYNTHESIS OF DEOSYRIBONUCLEIC ACID IN NORMAL AND TUMOUR STRAIN CELLS. John Seed (Cambridge Univ., Eng.). Nature, 192: 944-5(Dec. 9, 1961).

Recent data on the effects of radiation on the synthesis of desoxyribonucleic acid (DNA) in normal and tumor-strain cells are reviewed. Results are presented from studies in three types of freshly prepared normal cells grown in culture and in cells from two mouse tumor strains that indicate a time-disconnection of nuclear protein and DNA synthesis in tumor cells. It is suggested that the difference in timing of the onset of nuclear protein synthesis reflects a fundamental difference in metabolism between normal and tumor-strain cells. It is concluded that the time-disconnection of DNA and nuclear protein synthesis found in tumor strains implies dislocation of control of phosphorylation. This would be consistent with the lack of radiosensitivity found in the DNA pre-synthetic period in these cells. (C.H.)

5198 CHANGES IN THE RADIOGRAPHIC PICTURE OF CANCER OF LUNG FOLLOWING TELEGAMMA THERAPY. S. Ya. Marmorshtein and T. N. Matveeva (Herzen State Oncological Inst., Moscow). Problems of Oncol. (U.S.S.R.) (English Translation), 7: 321-31(Nov. 1961).

During telegamma treatment one may detect a definite regression of the tumor — a disappearance of diminution in size of a peripheral cancer (in 28 of the 36 case observations) and a complete or partial re-expansion of the atelectasis in central cancer (in 18 of the 38 cases). The effect of irradiation continues even after the conclusion of the treatment course, in some cases for as long as four or five months after completion of telegamma therapy. Even the complete disappearance of radiological signs of a tumor does not by any means denote cure of the patient, inasmuch as resurgence of tumor growth after its seemingly complete disappearance was observed in seven patients with peripheral and five with central lung cancers. Our observations confirm the absolute necessity of simultaneous irradiation of the tumor itself, the routes of lymph flow, and the zones of regional metastasization (lung hila and mediastinum) not only in patients with metastases in lymph nodes but also in patients in whom the most thorough radiological investigation has failed to reveal enlarged lymph nodes. (auth)

5199 THE INFLUENCE OF IONIZING RADIATION ON THE INDUCTION OF LUNG ADENOMAS IN MICE BY MEANS OF URETHANE. L. A. Gritsyute (Inst. of Oncology, Lithuanian Ministry of Health, Vilnius). Problems of Oncol. (U.S.S.R.) (English Translation), 7: 386-91(Nov. 1961).

The blastomogenic action of ionizing radiation, namely x rays and the radioactive isotope P^{32}, on the lungs of mice is quite a feeble one. It is distinctly less than the blastomogenic substances. A tumorigenic action of radioactive Ru^{103} was not observed in the experiments. When using x rays and P^{32} along with injection of mice with urethane one notes a considerable suppression by radiational factors of the process of blastomogenesis in the lungs of mice. (auth)

5200 THE CAUSES OF THE INEFFECTIVENESS OF AMINOETHYLISOTHIURONIUM DURING IRRADIATION OF THE CELLS OF SOME TUMOURS. E. N. Tolkacheva and N. I. Shapiro (Inst. of Biophysics, Academy of Medical Sciences, Moscow). Problems of Oncol. (U.S.S.R.) (English Translation), 7: 391-6(Nov. 1961).

The absence of a protective effect of β-aminoethylisothiuronium Br. HBr (AET) during irradiation of cells of Ehrlich's ascites tumour is determined by the pH value of the medium containing these cells. Mercaptoethylguanidine (MEG), a derivative of aminoethylisothiuronium, protects the cells of Ehrlich's ascites tumour. The protective action of mercaptoethylguanidine during irradiation of Ehrlich's ascites tumour is realized at a later time than is the protection of the cells of normal tissues. (auth)

5201 CANCER OF THE PERINEAL SKIN ARISING AFTER X-RAY THERAPY OF ECZEMA. R. A. Mel'nikov and S. S. Yaritsyn (Inst. of Oncology, Academy of Medical Sciences, USSR). Problems of Oncol. (U.S.S.R.) (English Translation), 7: 413-16(Nov. 1961).

The history is presented for a case of cancer of the perineal skin which developed after extensive x-ray therapy administered for a benign condition. The cancer was removed successfully by electrosurgical excision. (C.H.)

5202 RADIATION DAMAGE TO CYTOCHROME C AND HEMOGLOBIN. K. S. Ambe, U. S. Kumta, and A. L. Tappel (Univ. of California, Davis). Radiation Research, 15: 709-19(Dec. 1961).

Radiation-induced damage to cytochrome c and hemoglobin has been defined by: transformation into insoluble protein aggregates and scission products, radiolability of amino acids, and loss of biological redox or oxygen-binding properties. The insoluble aggregates are not formed by simple mechanisms involving cross-linking or denaturation of proteins. Radiation-induced hydrolysis of proteins per se is not the cause of scission. More complex mechanisms are suggested by the marked deviation in the amino acid pattern of these fractions from that of the original protein or TCA-precipitable protein. Methionine, histidine, phenylalanine, cystine, serine, and threonine are the most radiolabile amino acids in cytochrome c and hemoglobin. (auth)

5203 RADIORESISTANCE OF A PSEUDOMONAS SPECIES ISOLATED FROM THE OMEGA WEST REACTOR. A. Anellis (U. S. Army Quartermaster Research and Engineering Command, Chicago). Radiation Research, 15: 720-3(Dec. 1961).

The radioresistance of an unidentified species of Pseudomonas contaminating the Omega West Reactor, Los Alamos Scientific Laboratory, was determined under controlled conditions. The organism was found to be much more sensitive to γ-radiation than originally reported. It had a D value of only 4.4 to 5.6 krad, while a population of 10^8 cells/ml could be inactivated by 45 to 57.5 krad. (auth)

5204 THE EFFECT OF TOTAL-BODY X-IRRADIATION ON REPRODUCTION OF THE FEMALE BEAGLE TO 4 YEARS OF AGE. A. C. Andersen, F. T. Shultz, and T. J. Hage (Univ. of California, Davis.). Radiation Research, 15: 745-53(Dec. 1961).

Female beagles exposed to either 100 r or 300 r (midline tissue dose in air) at puberty (351 ± 8 days) were tested for reproductive ability by whelping two litters before 4 years of age. First litters were whelped at an average of 671 days and second litters at 1001 days of age. Conception rate compared favorably between treatments, and pup viability first and second litters from irradiated dams equaled or bettered that from controls. No differential causes of puppy mortality were discernible in the 297 litters totaling 644 pups. Secondary sex ratios were not significantly different between treatments; more males than females were whelped from irradiated dams, but more females survived to weaning age. The conclusion is that a female dog surviving total-body x irradiation at puberty will not suffer loss in fertility to 4 years of age. (auth)

5205 THE PREDICTABILITY OF IRREPARABLE BIOLOGICAL DAMAGE FROM EXPOSURE TO IONIZING RADIATION. J. F. Spalding, T. T. Trujillo, and W. L. LeStourgeon (Los Alamos Scientific Lab., N. Mex.). Radiation Research, 15: 754-60(Dec. 1961).

Nine hundred female RF mice (five groups) were given preliminary exposures of Co^{60} γ-rays ranging from 0 to 2000 rads by the biweekly fractionation method. After 90 days of no irradiation, all groups were exposed to 450 rads of Co^{60} γ-rays biweekly to death. Accumulated median lethal doses and their equivalent acute values were calculated and compared to predicted values based on 5% irreparable injury and a 7-day repair half-time. Predictions were accurate to within 3% of the calculated equivalent acute value. (auth)

5206 RADIATION EFFECTS ON SKIN AND SUBCUTANEOUS TISSUE. A QUANTITATIVE STUDY OF COLLAGEN CONTENT: MODIFICATION WITH L-TRIIODOTHYRONINE. Toshio Kitagawa, Arvin S. Glicksman, Ella B. Tyree, and James J. Nickson (Memorial-Sloan-Kettering Cancer Center, New York). Radiation Research, 15: 761-6(Dec. 1961).

The results of direct measurement indicate that hydroxyproline increases in irradiated skin and subcutaneous tissue. Under the influence of the thyroid analog L-triiodothyronine, this accumulation is reversed. The nonirradiated tissues which normally increased in hydroxyproline content with age have also been found to have a decrease in this constituent. (auth)

5207 CHROMOSOMAL ABERRATIONS IN IRRADIATED AND NITROGEN MUSTARD TREATED MICE. K. G. Stevenson and H. J. Curtis (Brookhaven National Lab., Upton, N. Y.). Radiation Research, 15: 774-84(Dec. 1961). (BNL-5450)

Chromosome aberrations in regenerating mouse liver have been used as an index of somatic mutations to assess the role of mutations in normal aging and in life shortening caused by radiation and other agents. The experiments consisted of a group of mice given a single dose of 700 r of x rays at age 8 weeks; groups of mice given three intraperitoneal injections weekly of 0.003 mg or 0.01 mg of nitrogen mustard; and saline-injected controls. They were followed until 12 months of age. Normal mice exhibited steadily increasing numbers of abnormalities with age, reaching 22% at 10 months. After a single dose of x rays, a high proportion of cells showed aberrations, which declined less than 50% over a 6-month period. The rate of accumulation of abnormalities in the nitrogen mustard-treated groups did not differ from the rate in the controls. Statistical analysis showed that the abnormalities in the two nitrogen mustard groups taken together were an average 5% greater than in controls. The 0.003-mg group did not differ significantly from the 0.01-mg group. In so far as chromosome abnormalities in these cells are indicative of somatic mutations, these results suggest that mutations may contribute a real but not decisive part in natural and radiation-induced aging, and that nitrogen mustard is too weak a mutagen to shorten the life span significantly. (auth)

5208 ENZYMATIC CHANGES IN BETA-IRRADIATED EPIDERMIS OF GUINEA PIGS. I. FREE AND INHIBITOR-BOUND RIBONUCLEASE. Joseph Tabachnick (Albert Einstein Medical Center, Philadelphia). Radiation Research, 15: 785-97(Dec. 1961).

After irradiation of the skin of guinea pigs with a single surface dose of 3000 rep of β-radiation from an Sr^{90} – Y^{90} sealed source, there was a progressive increase in epidermal RNase activity (pH 7.7) which by the second week reached a peak about three times the control value. Depending on the method of preparation of tissue for assay, a significant increment in activity was observed as early as the first day or not later than the sixth day after irradiation. During this interval there were no grossly visible signs of injury. Microscopically, however, various alterations were readily seen, and the progressive rise in enzymatic activity paralleled the increase in dead and dying cells. After thin strips of peeled irradiated tissue were washed prior to homogenization, a progressive increase in RNase activity was observed in the wash, suggesting leakage of enzyme from damaged cells. This increase could be accounted for, at least in part, by a decrease in inhibitor-bound RNase (*i*-RNase) in the irradiated tissue. The threshold dose for inducing increased RNase activity was about 600 rep of β-radiation. It is suggested that the observed rise in enzymatic activity constitutes a phase of the general response of cells to injury. Radiation, like other types of injury, may initiate the autolytic process which releases the enzymes or destroys their inhibitors. (auth)

5209 EFFECT OF X-IRRADIATION ON ZINC-65 METABOLISM IN MICE. Kunio Matsui, Kiyomasa Kometani, and Kei Yaeno (Osaka City Univ.). Radiation Research, 15: 798-809(Dec. 1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 42.

5210 THE EFFECT OF INJECTED FAT EMULSION ON SURVIVAL OF RATS EXPOSED TO TOTAL-BODY IRRADIATION. Hugo C. Moeller and Jerome M. Vaeth (Univ. of California, San Francisco). Radiation Research, 15: 810-13(Dec. 1961).

The possible effect of fat emulsion given parenterally either before or after total-body irradiation was studied. It appears that large doses of fat emulsion administered to rats after total-body irradiation may be detrimental to survival. (auth)

5211 THE EFFECT OF HIGH-PROTEIN DIETS ON RENAL HYPERTROPHY IN RATS AFTER WHOLE-BODY IRRADIATION. Frank Konishi, V. J. Rosen, and R. W. Brauer (Naval Radiological Defense Lab., San Francisco). Radiation Research, 15: 822-8(Dec. 1961).

The relationship between high-protein intake and increase in kidney weight was investigated in rats exposed to a single dose of 375 rads of x radiation. Attempts were made to characterize the degree of renal hypertrophy and hyperplasia involved by employing radiation as an inhibitor of cellular proliferation. Rats were fed a high-protein diet and exposed to radiation at various points of the feeding regime. The high-protein diet significantly increased kidney weight in all cases, but the increase was not influenced by the x ray dose employed or the time of administration. However, histological studies of the kidneys showed that radiation reduced the incidences of abnormal tubular hyperplasia. The renal lesions also appeared much earlier than previously reported by other investigators. Rats fed high-protein diets appeared to recover from the radiation-induced loss in body weight at a faster rate than those fed a basal diet. A possible mechanism is briefly discussed. (auth)

5212 THE EFFECT OF INTRAPERITONEAL INJECTION ON AVERSIVE BEHAVIOR CONDITIONING WITH X-IRRADIATION. Barron B. Scarborough and William A. McLaurin (Florida State Univ., Tallahassee). Radiation Research, 15: 829-35(Dec. 1961).

Fifty-six rats of the Wistar Strain were randomly assigned to eight experimental or control groups. The conditioning of aversive behavior to a preferred saccharin solution by means of x irradiation was investigated under the treatments of sham irradiation, saccharin solution available during irradiation, and intraperitoneal injection of alcohol, distilled water, or saccharin solution. Conditioned aversive behavior to saccharin solution was found in the group receiving saccharin to drink during irradiation. Injection of saccharin solution followed by irradiation did not produce aversive conditioning, and the first hypothesis was supported. It was also found that distilled water intraperitoneally injected seemed to offset the effects of irradiation, and thus the second hypothesis that intraperitoneal injection of alcohol or distilled water would have no effect on aversive behavior conditioning was held to be untenable under the conditions of this experiment. (auth)

5213 LEUKEMOGENESIS BY URETHAN IN C57B1 MICE BEARING ISOLOGOUS TISSUES FROM X-IRRADIATED MICE. I. Berenblum and N. Trainin (Weizmann Inst. of Science, Rehovoth, Israel). Science, 134: 2045-6 (Dec. 22, 1961).

A single exposure of mice of a low-leukemic strain (C57Bl/6) to 400 r of total-body x irradiation caused the early appearance of a factor which, though not itself capable of inducing leukemia in adult C57Bl recipients, did cause its appearance when the recipients also received urethan by injection. Positive results were obtained with seven different tissues from irradiated animals, whether urethan was injected 1 day or 30 days after the irradiation. No such effect was obtained in either series in the absence of urethan treatment. When urethan was injected into normal C57Bl mice, or into mice previously implanted with tissues from nonirradiated mice, only marginal leukemogenic activity was evinced. The possible involvement of a precursor virus is discussed. (auth)

5214 ANOMALOUS GREYING EFFECT IN MICE WITH HIGHER DOSES OF X-RAYS. Donald B. Galbraith and Herman B. Chase (Brown Univ., Providence). Science, 135: 96-7(Jan. 12, 1962).

Exposure of mouse hair follicles to 1200, 1300, and 1400 r of x rays results in delay of hair growth, precocious melanogenesis, and disruption of melanocyte distribution. The diversity of greying responses obtained with 1100 to 1700 r appears to be due to inactivation of radiosensitive follicles rather than to tissue replacement or to displacement of external sheath melanocytes into the hair bulb. (auth)

5215 RADIATION CANCER OF THE LUNG: TISSUE SENSITIVITY AND FACTORS INFLUENCING DOSAGE FROM AIRBORNE RADIOACTIVE SUBSTANCES. Norton Nelson (New York Univ.-Bellevue Medical Center, New York). p.221-30 of "Inhaled Particles and Vapours." New York, Pergamon Press, 1961.

Factors determining the carcinogenic dosage of radiation to lung tissue are discussed. These include the intrinsic sensitivity of the target tissue to radiation carcinogenesis, access of the radioactivity to the target tissue, rate and mode of elimination, and duration of exposure. The tissue of interest in bronchogenic cancer is the bronchial epithelium, and in particular the basal cells. Irradiation of basal cells from aerosol particles reaching the surface or its mucous covering, or from radiation reaching the basal cells from within the lung tissue is discussed. It is pointed out that the location of the radioactivity with respect to the target cells may be critically important, especially when soft Bond α radiations are involved. Data are tabulated on the radiation dose to various regions of the human respiratory tract resulting from the inhalation of 10^{-9} c/l radon in equilibrium with its daughters, and the radiation dose level and cancer incidence for radioactive pellet implants in the respiratory tract. (C.H.)

5216 STRAHLENBEDINGTE LEBENSVERKÜRZUNG. PATHOLOGISCHE ANATOMIE SOMATISCHER SPATWIRKUNGEN DER IONISIERENDEN GANZKORPERBESTRAHLUNG AUF DEN ERWACHSENEN SAUGETIERORGANISMUS. (Radiation Controlled Life Shortening. Pathological Anatomy of Somatic Late Effects of Ionizing Whole-Body Irradiation on Adult Mammal Organisms). Hans Cottier. Berlin, Springer-Verlag, 1961. 472p. DM 98.

The late effects of acute total-body irradiation are discussed. Morphological and pathological testing was carried out on individual animals to determine the chronological order of the appearing injuries and identify the macroscopically and microscopically visible causes of death. The methods used in the investigation and the effects of experimental conditions are described. General condition of the animal, body weight, skeleton length increase, mortality, cardiovascular system, respiratory tract, digestive tract and organs, kidneys and urinary organs, male sex organs, female sex organs and mammary, endocrine organs (except gonads), sense organs, nervous system, movement apparatus, and skin are discussed. (M.C.G.)

5217 DIE SUPERVOLTTHERAPIE. GRUNDLAGEN, METHODEN UND ERGEBNISSE DER THERAPIE MIT ENERGIEREICHEN TEILCHEN UND ULTRAHARTEN STRAHLEN. (Supervoltage Therapy. Fundamentals, Methods, and Results of Therapy with Energetic Particles and Ultrahard Radiation). J. Becker and G. Schubert. Stuttgart, Georg Thieme Verlag, 1961. 596p. $36.25.

The development and biophysical basis of supervoltage therapy using ultrahard x-rays, gamma rays, and electrons with energies of more than one million volts are discussed. The production of ultrahard radiation, its characteristics, and interactions with matter are described. Dosimetry methods used in supervoltage therapy are outlined. The biological basis for supervoltage therapy is discussed. Irradiation techniques used in this type of therapy are described. The effects of this high energy radiation on all types of tumors are summarized. Radiation protection is discussed, especially the special protection problems in the therapeutic uses of radiation. (M.C.G.)

Radiation Sickness

Refer also to abstracts 5162, 5163, 5166, 5167, 5168, and 5171

5218 (A/AC.82/G/L/.671) SEX-RATIO—AN UNRELIABLE METHOD FOR ESTIMATIONS OF RADIATION HAZARDS. K. G. Luening (Stockholm. Univ. Lab. of Radiation Genetics). Nov. 1, 1961. 23p.

In studies of offspring to daughters of male mice with irradiated spermatozoa or spermatogonia, it was found that the sex-ratio insignificantly exceeded the controls although a deficit of males was expected if some of the F_1 females were heterozygous for sex-linked lethals. By subdividing the material in small (1 to 4 young) and large litters (5 and more) it was, however, possible to show that the sex-ratio in small litters was lower than the controls, indicating the presence of sex-linked lethals. The large litters, however, showed an unforeseen excess of males compared to the corresponding controls. The occurrence of other factors than sex-linked lethals in provoking changes in the sex-ratio is discussed in relation to the use of human data to estimate radiation hazards. It was concluded that until more is known about the various factors which might influence the sex-ratio, such estimates for man are completely unreliable. (auth)

5219 (AF-SAM-61-87) POTENTIATION BY PENTOBARBITAL OF THE PROTECTIVE EFFECT OF AET AGAINST GAMMA RAYS. George S. Melville, Jr. and Thomas P. Leffingwell (Texas. Univ., Austin. Radiobiological Lab.). Oct. 1961. 8p.

Issued by School of Aerospace Medicine, Brooks AFB, Tex.

Female rats were treated with the radioprotective drug S,beta-aminoethylisothiuronium dibromide (AET) in combination with pentobarbital sodium and irradiated with various dosages of gamma rays. This treatment appears to depend less on dose rate of radiation than does AET given alone; it also reduces the amount of AET which must be used to achieve a given degree of protection. The combination is more effective than either compound given singly. The results of this study support further the hypothesis that chemical agents with different modes of action may be successfully combined to achieve better radioprotection. (auth)

5220 RESIDUAL RADIATION INJURY: IMPAIRED REGROWTH OF REALIMENTED HYPOCALORICALLY REARED RATS. H. W. Carroll and R. W. Brauer (Naval Radiological Defense Lab., San Francisco). Am. J. Physiol., 192: 1078-82(Dec. 1961).

Hypocalorically reared rats were subjected to single exposures of x ray ranging from 400 to 700 rad or to repetitive exposures of 200 rad in four doses spaced 1 week apart (total 800 rad). They were allowed to recover for a minimum of 7 weeks and a maximum of 6 months after the last exposure and then returned to an adequate caloric intake. Realimentation of the irradiated populations resulted in reduced regrowth when compared to nonirradiated realimented rats of the same age. The reduction in regrowth persisted regardless of radiation exposure patterns, realimentation patterns, or the recovery periods here employed. Paired feeding demonstrated that the regrowth reduction is primarily one of reduced nutrient utilization. Gastrointestinal tract shielding showed that injury to the intestinal region with impaired absorption is probably not the cause. It is concluded that the reduced regrowth of the irradiated realimented rats is a generalized deficiency of nutrient utilization by the organs and tissues, perhaps mediated through the endocrines. (auth)

5221 THE ANALYSIS OF INJURIES AND REPARATIVE PROCESSES IN THE EMBRYOGENESIS OF RATS AFTER X-RAY IRRADIATION. E. A. Val'shtrem (Leningrad State Pedagogical Inst. and Inst. for Experimental Medicine, Academy of Medical Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 140: 1434-6(Oct. 21, 1961). (In Russian)

It was observed that the administration of a total, x-ray dose of 130 r to the fetus of a rat on the 10th day after conception led to an increase in the percent of anomalous embryos during the first 3 days after irradiation, but that there was a significant decrease in the number of anomalous embryos after this 3 day period due to the effectiveness of reparative processes. Since it is well known that x-rays suppress the mitotic activity of cells, a comparison was made of the change in percent mitoses of brain cell tissue of irradiated and normal embryos. The mitotic activity of a normal embryo decreases from 42.13% on the 11th day to 27.32% on the 17th day of development. An embryo irradiated on the 10th day after conception shows only 11.68% of the cell dividing on the 11th day after conception (one day after irradiation). The mitotic activity of the irradiated embryo cells then increases until it approaches the normal level of about 28% on the 14th day after conception. The restoration of mitotic activity is a strong indication of reparative processes occurring in the embryonic brain. The greater the damage observed after irradiation, the lower is the mitotic activity observed in the embryonic, brain cell tissue. (TTT)

5222 THE PROTECTIVE ACTION OF NATIVE AND PURIFIED CONCENTRATED SERA OF IRRADIATED ANIMALS AGAINST RADIATION SICKNESS. A. T. Kravchenko and V. I. Fofanov. Med. Radiol., 6: No. 8, 23-7(Aug. 1961). (In Russian)

The resistance of white mice and guinea pigs to the action of gamma radiation following preliminary immunization with a homologous serum obtained from previously irradiated animals was studied. The resistance of the animals rises if the last administration of the serum was effected 15 days before the irradiation. Introduction of serum obtained from nonirradiated animals also changes the resistance of animals to irradiation, however to a lesser degree. A conjecture was made on the presence of a specific factor in the serum of irradiated animals that causes immunologic reorganization of the organism and elevates its radioresistance. (auth)

5223 THE RADIOPROTECTIVE ACTIVITY OF CERTAIN DERIVATIVES OF TRYPTAMINE AND ITS HOMOLOGUES. P. G. Zherebchenko, N. N. Suvorov, V. S. Murashova, M. N. Preobrazhenskaya, N. P. Sorokina, and M. V. Fedotova. Med. Radiol., 6: No. 8, 27-32(Aug. 1961). (In Russian)

5224 PREVENTION OF DEPOLYMERIZATION OF LIVER DNA IN THE IRRADIATED RATS WITH THE AID OF RADIOPROTECTIVE SUBSTANCES. L. S. Isupova and V. S. Balabukha. Med. Radiol., 6: No. 8, 36-41(Aug. 1961). (In Russian)

The possibility of preventing depolymerization of the liver DNA in irradiated rats was studied with the aid of protective substances prophylactically introduced into animals. Administration of certain aminothiole protective agents (β-mercaptoethylamine, bromhydrate of propyl ether, cysteine, and α-cysteine), as well as one pyrimidine derivative (3-allyl-4-aminouracil), precludes depolymerization of DNA molecules of the liver in rats immediately after irradiation. The degree and duration of DNA protection with the aid of these substances varies. (auth)

5225 THE SMALL INTESTINE IN ACUTE RADIATION DEATH IN THE DOG. Stanley Wing Handford and Paul W. Johnson (National Naval Medical Center, Bethesda, Md.). Radiation Research, 15: 734-44(Dec. 1961).

Survival time and changes in venous hematocrit and rectal temperature were measured in anesthetized, eventrated dogs after 3000 r of x irradiation under the following conditions of exposure: normal unoperated total-body-irradiated controls; eventrated total-body-irradiated controls; body-protected, gut-irradiated eventrated group; and body-irradiated, gut-protected eventrated group. Both partially protected groups survived significantly longer than the normal control group and the eventrated control group, the body protected, gut-irradiated eventrated group relatively longer than the other three. The eventrated controls survived as long as the unoperated normal controls. Weight loss and hemoconcentration were less in the gut-protected animals. It is suggested that there is less fluid loss in this group owing to the protection of the gut. Histopathologic study of the intestine (jejunum and ileum) suggests that at death there may be some sparing of crypts in dogs with the intestine irradiated. In one case, major recovery occurred in an animal that survived 112 days. There is also evidence that shielding of the intestine was not 100% effective in all cases. It is concluded that exposure of the intestine alone to a supralethal dose of x radiation is not tantamount to total-body irradiation. The validity of considering intestinal radiation death a true modality is discussed. (auth)

5226 REDUCTION OF X-RAY LETHALITY IN MICE BY AGENTS AFFECTING THE RETICULOENDOTHELIAL SYSTEM. H. Balner, L. J. Old, and D. A. Clarke (Sloan-Kettering Inst. for Cancer Research, New York). Radiation Research, 15: 836-49(Dec. 1961).

Mortality of mice irradiated several weeks after administration of *mycobacterium tuberculosis* and zymosan was significantly reduced. There was no accelerated recovery of hemopoietic and lymphatic tissue in the protected animals. Certain enhanced activities of the reticuloendothelial system related to increased nonspecific resistance were still evident after lethal irradiation. A correlation between resistance to near-lethal irradiation and certain parameters reflecting the functional state of phagocytic elements of the reticuloendothelial system is postulated. (auth)

CHEMISTRY

General and Miscellaneous

5227 THE FIFTH INTERNATIONAL SYMPOSIUM ON FREE RADICALS, JULY 6-7, 1961, INSTITUTE OF PHYSICAL CHEMISTRY, UPPSALA UNIVERSITY, UPPSALA, SWEDEN. (Preprints of Papers). Stockholm, Almqvist & Wiksell, [1961]. 806p.

Sixty-nine papers are included; separate abstracts have been prepared for thirty-five. Sixty-one of the papers are in English, five in German, and three in French. The following topics are discussed and described: low temperature stabilization of free radicals, free radicals trapped in macromolecular systems, free radical reactions at low temperatures, spectra of free radicals, electron spin resonance of free radicals, properties and reactions of radicals produced by high energy radiation, and photochemistry of free radicals. (N.W.R.)

5228 ELECTRON SPIN RESONANCE OF STABLE ORGANIC FREE RADICALS: THE DISSOCIATION OF HEXAPHENYLETHANE. John A. Weil (Argonne National Lab., Ill.). 3p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

A determination of the equilibrium constant K of dissociation of hexaphenylethane (HPE) in benzene into triphenylmethyl (TPM) radicals is made by means of paramagnetic resonance. The resonance experiments are carried out at 23 kMc/sec at room temperature. The total HPE concentration, c, is analyzed by reaction with excess iodine and back titration with standard thiosulfate solution. The TPM concentration, c_r, present at equilibrium is found by measuring the area under the resonance absorption curve displayed on an oscilloscope. The conversion of these areas to free radical concentration is carried out by comparison with known samples of 2, 2-diphenyl-1-picrylhydrazyl (DPPH) in benzene. The equilibrium constant $K = c_r^2(c - c_r/2)^{-1}$ is determined for three concentrations: 0.0875, 0.127, and 0.131 mole/l, and is found to have the mean value of $2.92 \pm 0.09 \times 10^{-4}$ mole/l at 23°C. (N.W.R.)

5229 FORMATION, STABILIZATION AND SUBSEQUENT REACTIONS OF HYDROGEN ATOMS IN SOLIDS AND THEIR IMPORTANCE IN RADIOLYSIS. V. Voevodskii (Voevodsky) (Moscow State Univ.). 22p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

The formation of hydrogen atoms in frozen diluted acids, on solid surfaces at 77°K, and under similar conditions by ultraviolet irradiation is discussed along with the elucidation of the stabilization mechanism and further chemical conversions of these atoms within a temperature range of 100 to 150°K. Certain conclusions on the importance of hot primary atoms formed in radiolysis of solid hydrocarbons are also drawn from data on solid- and liquid-phase radiolysis. (N.W.R.)

5230 THE PHOTOLYSIS OF TOLUENE, DIBENZYL AND BENZYL CHLORIDE IN RIGID MEDIA: STUDIES BY ABSORPTION AND LUMINESCENCE SPECTROSCOPY. Sydney Leach and Lydie Grajcar (Laboratoire de Chimie Physique, Paris). 24p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

In the study of $C_6H_5CH_2X$ molecules, limited here to toluene, dibenzyl, and benzyl chloride, both absorption and luminescence techniques are used for identifying photochemical products. The luminescence techniques are found to be often more sensitive than absorption spectroscopy in the detection of these products. Hence some unreported primary and secondary photochemical reactions occurring for these molecules in low temperature glasses are now shown to exist. Information is also obtained on the mobility of primary free radicals. Significant photochemical differences are also observed for matrices of different composition and rigidity. A brief review of the studies of other workers on the radiolysis and photolysis of these systems in both the liquid and solid states is discussed. A table is presented showing the photochemical products observed by absorption and luminescence spectroscopy after ultraviolet radiation of isopentane and EPA (5 : 5 : 2 proportions of ethyl ether, isopentane, and ethyl alcohol) solutions at 77°K. (N.W.R.)

5231 PARAMAGNETIC RESONANCE LINE WIDTHS IN SOME IRRADIATED ORGANIC CRYSTALS. Harold C. Box, Harold G. Freund, and Kenneth Lilga (Roswell Park Memorial Inst., Buffalo). 3p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

Paramagnetic resonance line widths in irradiated molecular crystals of glycyl glycine, acetyl glycine, malonic acid, acetyl DL alanine, chloroacetyl DL alanine, and dimethylmalonic acid are compared. Irradiation produces structurally related free radicals in the first three mentioned compounds. In the last three compounds the irradiation produces free radicals whose hyperfine spectra result from hyperconjugation interactions between the unpaired electron and methyl protons. Assuming rapid rotation of the methyl group in the last three compounds, the orientations of the free radicals are magnetically equivalent except in the case of acetyl DL alanine. The hyperfine spectra of the glycine derivatives and malonic acid are essentially unaltered at 4.5°K, but their spin-lattice relaxation times are about 0.1 sec. The spectra of the alanine derivatives and dimethylmalonic acid become complex and poorly resolved at 4.5°K presumably due to cessation of methyl group rotation. The spin-lattice relaxation times are less than 0.1 sec. (N.W.R.)

5232 TRAPPED SPECIES AND CHEMICAL SYNTHESIS AT CRYOGENIC TEMPERATURES. Henry A. McGee, Jr. (Georgia Inst. of Tech., Atlanta). 43p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

A review is given of the free radicals obtained by chemical synthesis at cryogenic temperatures and the characteristics of the trapped or frozen free radicals. The discussions are concerned specifically with reactivity, mechanism, structure, kinetics, stabilization, solubility, and properties. (N.W.R.)

5233 ELECTRON SPIN RESONANCE STUDIES ON THE GEOMETRY OF TRAPPED RADICALS. D. H. Whiffen (National Physical Lab., Teddington, Meddx., Eng.). 4p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

Examples are given which show some of the information on the geometry of free radicals formed by radiation damage and trapped in crystalline materials. The information is obtained from the electron spin resonance studies by deducing the arrangement of the radical in the crystal lattice and thence obtaining in favorable cases some information about the radical shape. Occasionally the magnitude of the complete hyperfine coupling tensor or the degree of anisotropy may give additional information. (N.W.R.)

5234 ELECTRON RESONANCE EXAMINATION OF TRAPPED RADICALS RESULTING FROM RADIATION DAMAGE TO ORGANIC SINGLE CRYSTALS: UREA COMPOUNDS. Roy S. Anderson (Clark Univ., Worcester, Mass.) and Thadho S. Jaseja. 9p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell. [1961]. (In English)

No resonances were observed in urea and thiourea single crystals when they were examined by electron resonance techniques after x and gamma irradiation at room temperature. This is interpreted to indicate that the lifetimes of any resulting unstable species must be less than 30 minutes at room temperature. However, methylurea and ethylurea showed strong, highly stable spectra centered at $g = 2$. Analyses of these spectra suggest that the trapped radicals were formed by the loss of a hydrogen atom. The radicals in the unit cell were considered to be magnetically equivalent. The spin density of the unpaired electron at the adjacent N–H group is believed less than 0.002, since the only apparent effect of this group was a broadening of the hyperfine lines. (N.W.R.)

5235 REACTIONS IN γ-IRRADIATED ALKYL HALIDES AND SULPHONES. P. B. Ayscough, K. J. Ivin, J. M. O'Donnell, and C. Thomson (Univ. of Leeds, Eng.). 21p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

Electron spin resonance spectroscopy is used for studying the reactions of radicals in gamma irradiated alkyl halides and sulfones. The method is unique in permitting the simultaneous identification and estimation of concentration of paramagnetic species over a wide range of temperatures, even when little is known of the products of the reaction. In irradiated alkyl halides and sulfones the only paramagnetic species observed in high yield at −196°C are alkyl radicals, which are observed to isomerise but not to abstract hydrogen atoms from the parent molecule. At higher temperatures in irradiated sulfones hydrogen-abstraction does occur but the reacting species is probably not the simple alkyl radical. Thus, a dominant factor in all systems containing trapped radicals is the energy required to remove the radical from its trap which in turn is strongly dependent on the trapping matrix. (N.W.R.)

5236 A STUDY OF THE FREE RADICALS IN IRRADIATED NYLON. D. S. Ballantine and Y. Shinohara (Brookhaven National Lab., Upton, N. Y.). 21p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

The decay and nature characteristics of the free radicals which are produced in low crystallinity nylon 6 by gamma irradiation are discussed. It is shown that when nylon 6 is subjected to gamma irradiation the free radical which results is affected by irradiation temperature, irradiation dose, the measurement temperature, storage time, and storage environment. These results are explained by a mechanism which involves radical site migration and a hydrogen atom shift. (N.W.R.)

5237 LOW TEMPERATURE REACTIONS OF RADICALS IN IRRADIATED POLYMERS. A. Charlesby and M. G. Ormerod (Royal Military Coll. of Science, Shrivenham, Wiltshire, Eng.). 26p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

Results are given which show the value of correlating electron spin resonance (esr) and radiation chemistry of polymers in order to study the free radical reactions in the solid state. The polymers studied are polyethylene, polypropylene, polymethacrylic and polyoerylic acid and their esters, acrylamide, and polyvinyl chloride. The practice is to irradiate the polymers and observe the esr spectrum of a sample of the polymer at 77°K, at which temperature free radicals are presumably immobile. The sample is then warmed to room temperature and the reactions and decay of the free radicals followed. In many polymers the esr patterns for specimens irradiated at different temperatures differ widely, and this may assist in tracing the reactivity of the free radicals. Even when the radicals cannot be identified, the kinetics of their reactions can be determined, and this offers a very convenient manner of studying reactions in the solid state. (N.W.R.)

5238 RADICAL SPECIES DETECTED IN γ-IRRADIATED NITRATE CRYSTALS BY E.P.R. AND U-V SPECTRAL STUDIES. Joseph Cunningham (Argonne National Lab., Ill.). 3p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

Crystals were grown from aqueous solutions of twice recrystallized $KN^{14}O_3$ and $KN^{15}O_3$ and gamma irradiated at 4 or 77°K. EPR spectra were recorded with the crystal axis perpendicular or parallel to the resonance. The resonance was maintained perpendicular to the magnetic field. Results are listed only for $KN^{14}O_3$, but where triplets are tentatively identified with radicals containing bound nitrogen, doublets are recorded in $KN^{15}O_3$ crystals with total hyperfine splitting reduced in the ratio of the nuclear magnetic moments of nitrogen-14 and -15. Principal values of spectroscopic splitting factor and hyperfine splitting are given. (N.W.R.)

5239 ELECTRON SPIN RESONANCE STUDIES OF γ-IRRADIATED SMALL MOLECULES AT 4°K AND 77°K. Roland E. Florin, Daniel W. Brown, and Leo A. Wall. 17p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

Electron spin resonance spectra were observed for the species H, D, N, CH_3, CF_3, and SiF_3, produced by gamma irradiation of H_2, D_2, N_2, CH_4, CF_4, and SiF_4, respectively, at 4°K, and of CH_4, CF_4, and SiF_4 mixed with xenon at 77°K. The yields of CH_3 and CF_3 radicals per 100 ev absorbed (G-values) were much lower at 77°K. No radicals were found at 77°K in pure CH_4 and CF_4. The CH_3 and CF_3 spectra were closely similar to each other in xenon mixtures at 77°K. The spectrum from CF_4 irradiated at 4°K is totally different from the spectrum at 77°K. SiF_3 has a characteristic complicated spectrum at all temperatures. Decay phenomena are briefly mentioned. The low G-values are probably due to recombination with H and F atoms which would be rather mobile in molecular crystal matrices at 77°K and are evidently not trapped. (N.W.R.)

5240 RADICAL FORMATION AND TRAPPING IN TRITIUM-ENRICHED ICE. John M. Flournoy and Seymour Siegel (Aerojet-General Corp., Azusa, Calif.). 10p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

The formation of trapped OH radicals in ice at 77°K is shown as a function of the total dosage of beta and gamma radiation. Experimentally, the initial yields are apparently identical and therefore the single broken line shown is used to represent the common initial slope of 0.6 OH-radicals/100 ev. There is a pronounced difference in the dependence of the formation rate upon the total dosage, or upon the concentration of radicals already trapped. The net formation rate by the beta radiation at the termination of the experiment is only about 3%/day, so that uncertainties in the isothermal disappearance of OH at 77°K (about 0.5%/day) would become serious for significantly longer total irradiation times. The disappearance of OH at 100°K in the tritium enriched sample is followed quantitatively for several half lives starting very near the maximum concentration of 1.6 × 10^3 moles/liter. The linearity of the plot over 93% decomposition clearly demonstrates the applicability of the 3/2-order rate law for OH radicals produced by tritium beta and gamma radiation. (N.W.R.)

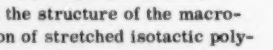
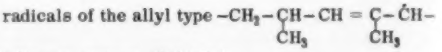
5241 ELECTRON SPIN RESONANCE STUDIES OF RADICALS FORMED BY X-IRRADIATION OF α-AMINO ISOBUTYRIC ACID. Minoru Fujimoto (Univ. of Maryland, College Park). 12p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

The single crystal of α-amino isobutyric acid, $(CH_3)_2(NH_2)CCOOH$, shows well defined spectra from the radical $(CH_3)_2\dot{C}COOH$ after irradiation by x rays (40 kv, 5 ma) at room temperature. This indicates that the C−N bond is apparently broken as a result of irradiation. At 100°K a simple triplet structure is found to be quite different from $(CH_3)_2\dot{C}COOH$. However, it is found that this structure changed to a spectrum from $(CH_3)_2\dot{C}COOH$ on warming up to 200°K. Thus the primary radical is stable only at cold temperatures. This radical is not clearly identified, but the radical is probably formed as follows. The radical $-CO\dot{O}$ is probably first formed by x rays. The carboxyl group is located at a position about 3 Å distant from the amino group in the adjacent molecule. The $-CO\dot{O}$ is then very likely linked with the amino group by hydrogen bonds. In this situation, the unpaired electron can interact with the nuclei in the amino group. Assuming a small nitrogen coupling in comparison with the proton couplings, an isotropic triplet is expected having relatively broad line widths. This radical may be energetically unstable, tending to transform to a more stable form by abstracting the amino group on warming and leaving the stable radical $(CH_3)_2\dot{C}COOH$ behind. The stable radical is also further explained by the motional effects and structure at low temperature phases. (N.W.R.)

5242 THE ACTION OF UNPAIRED ELECTRONS ON POSITRON ANNIHILATION IN THE CONDENSED PHASE. V. I. Goldanskii (Lebedev Inst. of Physics, Moscow and Inst. of Chemical Physics, Academy of Sciences, USSR). 10p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

The experimental detection of positronium, an unstable atom consisting of a positron and an electron, is reviewed in respect to its possibilities for studies of free and unpaired electrons in the gaseous and condensed phases. The combination of various methods gives a fairly reliable theory on the mechanism of generation and quenching of positronium atoms, particularly on the role of radicals in such processes. (N.W.R.)

5243 ESR−STUDIES IN IRRADIATED POLARIZED POLYPROPYLENE. H. Fischer and K.-H. Hellwege (Deutsches Kunststoff-Institut, Darmstadt, Ger.). 10p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In German)

Results are obtained about the structure of the macroradicals formed by irradiation of stretched isotactic polypropylene by investigation of the anisotropy of the electron spin resonance spectra. On irradiating at a temperature of 77°K, radicals of the structure  $-CH_2-\underset{CH_3}{CH}-CH_2\,\underset{CH_3}{\dot{C}}-CH_2-\underset{CH_3}{CH}-$ are formed to a dominating extent. However, at room temperature, radicals of the allyl type  $-CH_2-\underset{CH_3}{CH}-CH=\underset{CH_3}{C}-\dot{C}H-$ $\underset{CH_3}{CH}-$ are highly persistent. (N.W.R.)

5244 EXPERIMENTAL METHODS FOR STUDYING FREE RADICALS USING THE TIME-OF-FLIGHT MASS SPECTROMETER. D. B. Harrington (Bendix Corp., Cincinnati). 26p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

A description is given of a time-of-flight mass spectrometer followed by explanations of several features useful for free radical studies, including the instrument's ability to measure appearance potentials. (N.W.R.)

5245 ESR OBSERVATIONS OF THE RATES OF FORMATION AND REACTION OF FREE RADICALS PRODUCED BY HYDROGEN ATOM BOMBARDMENT OF POLYSTYRENE. R. B. Ingalls (Atomics International, Canoga Park, Calif.) and Leo A. Wall. 8p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

A method is described for investigating the reaction of hydrogen and deuterium atoms with polystyrene, and the mechanism and kinetics of the reaction are discussed. The method is based on the fact that by freeze-drying benzene solutions of polystyrene, extremely finely divided fibrous fluffs can be formed. These fluffs are formed in a thin wall glass cylinder which can be placed in a tube passing through the cavity of an electron spin resonance spectrometer. The spectra obtained by passing a stream of atoms through the fluff at low pressures show sufficient accessibility of the polymer molecules to the atoms to obtain an observable number of free radical intermediates. Thus, the technique permits the direct observation of free radical intermediates during a reaction and thus permits the direct measurements of the rates of certain elementary reactions in a number of heterogeneous systems. Results show that the spectrum of the intermediate radical obtained during the bombardment of polystyrene with hydrogen atoms differs from that obtained with deuterium atoms. The differences are probably due to both abstractions and additions to the aromatic rings of the polymer. Isotope effects are also thought to change the reaction rates and the relative concentrations. (N.W.R.)

5246 SPIN RESONANCE OF ALKALI ATOMS IN INERT-GAS MATRICES. V. A. Bowers, E. L. Cochran, S. N. Foner, and C. K. Jen (Johns Hopkins Univ., Silver Spring, Md.). 17p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

The electron spin resonance spectra of cesium, lithium, potassium, sodium, and rubidium atoms were examined in the matrices of argon, krypton, and xenon at liquid helium temperature. The inert-gas matrix effects on the spectra of trapped alkali atoms are very similar to but much larger than those on trapped hydrogen atoms. The theoretical model used for the hydrogen atom cannot be used with the same effectiveness for the alkali atoms. The presence of high order multiplicities of trapping sites for certain alkali-matrix combinations is shown to be in need of a reasonable explanation. As probes for the study of solid state interactions, alkali atoms have certain advantages by having a wide range of nuclear spins and polarizabilities, but they suffer from the effects due to large atomic size, high perturbations of wave functions, and difficulties of interpretation. (N.W.R.)

5247 THE INFLUENCE OF MEDIUM RIGIDITY ON THE TERMINATION OF TRAPPED POLYMERIC RADICALS. T. T. Jones (Monsanto Chemicals Ltd., Newport, Eng.). 16p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

The graft polymerization of styrene onto pre-irradiated polyethylene by reaction at the trapped radicals is greatly influenced by the rigidity of the swollen polymer gel in which the polymerization takes place. This change in rigidity may be brought about by thermal treatment of the irradiated polyethylene. A considerable reduction in termination coefficient compared with reaction in free monomer, due to the immobilization of the polymeric radicals, is observed. The vacuum irradiation method and the equipment used for the experiment are described. (N.W.R.)

5248 HIGH ENERGY INDUCED FREE RADICAL FORMATION IN BENZENE–CARBON TETRACHLORIDE MIXTURES. H. Kallmann, W. Riedl, and N. Wotherspoon (New York Univ., New York). 4p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

An investigation is carried out in benzene–carbon tetrachloride systems using diphenylpicrylhydrazyl (DPPH) as scavenger in order to determine the formation of free radicals by high energy radiation and to correlate these results with the experiments of Chapiro et al. An electron paramagnetic resonance method is used to determine the amount of DPPH consumed by radicals produced by radiation. The results show that the rates of formation of free radicals in benzene and carbon tetrachloride are independent of DPPH concentration and are proportional to dose until almost all DPPH is consumed. This indicates that the radical capture efficiency is constant. The ratio of rate of formation in carbon tetrachloride to the rate in benzene is 240 to 1 for equal intensity of incident energy and if corrected for equal absorbed energy, 50 to 1. Small additions of carbon tetrachloride to benzene increase the number of free radicals very strongly. The number is constant above 50%. The marked decrease in free radical formation upon the addition of small quantities of benzene to carbon tetrachloride observed by Chapiro is not observed in these experiments. (N.W.R.)

5249 ON PROPERTY CHANGES IN HIGH POLYMERS IRRADIATED BY LOW-ENERGY ELECTRONS OR EXPOSED TO ELECTRICAL DISCHARGES. Andreas Kelen and Willi Dick (ASEA, Vasteras, Sweden). 2p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

In polystyrene, both low-energy electrons (about 1000 ev) and gas discharges appear to produce free radicals with considerable lifetimes, the reactions of which change the materials. Some evidence of considerable differences in the time dependence of radical decay, and of the final chemical changes, may suggest the possibility of some multi-stage processes, the steps of which are not yet clear. This brief investigation also shows that polyethylene has a strong absorption band in the infra-red spectrum, after being exposed to electrical discharges in highly purified nitrogen. This absorption band may be attributed to a double bond. This double bond may arise from a primary discharge initiated biradical through a slow time reaction with a time constant of a few hours. No radicals were found by electron paramagnetic resonance investigations. (N.W.R.)

5250 PRODUCTION AND TRAPPING OF N IN SODIUM AZIDE AT LOW TEMPERATURES. G. J. King and F. F. Carlson (Army Engineer Research and Development Labs., Fort Belvoir, Va.). 4p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

Studies are made of N^{14} radicals formed in crystalline sodium azide by x irradiation at low temperatures. The electron paramagnetic resonance spectrum of x-irradiated sodium azide powder is graphically shown at liquid nitrogen temperature. The separation of the hyperfine lines is 6.2 oe, and the central g value is 2.0021. Analysis of this spectrum has shown that it can be fitted by three equally spaced lines of equal intensity. The clear resolution and equality of the lines in the powder sample show that this resonance is predominantly isotropic. The three lines arise from the four allowed magnetic states of the $^4S_{3/2}$ ground state of nitrogen-14. Each of these states is split into three lines by the nuclear magnetic field. Thus the production of atomic nitrogen appears to be the result of x-ray photoreactions. (N.W.R.)

5251 INVESTIGATIONS ON THE ADSORPTION OF FREE RADICALS FORMED ON SOLID SURFACES BY CLEAVAGE AND BY IONIZING RADIATION. Ya. A. Zarifyanz, V. F. Kisselev, and G. G. Fedorov. 12p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

Results show that free radicals may be formed on the surface of a solid by cleaving the latter in vacuum or inert gas, and also by ionizing radiation. Thus, the results indicate that possible surface modifications may be made in order to obtain more effective adsorbents and fillers for high polymers. The investigations reported are concerned with chemical adsorption and heat of oxygen adsorption on highly-dispersive graphite obtained by grinding the sample in a laboratory eccentric vibration mill, and with the adsorption of water vapor and oxygen on samples of highly-dispersive quartz and aerosyl. The strong adsorption of oxygen by graphite seems to be due to chemical adsorption at the surface of a cleft. When graphite is ground in argon, no appreciable change in adsorption activity is observed. Consequently, graphite ground in argon may be considered as fit for studies of the mechanism of elementary surface reactions between various molecules and radicals. The results for surface hydration measurements before and after gamma irradiation of quartz and aerosyl show that strong surface dehydration is seen to take place during irradiation. Thus, independent evidence on decrease in the concentration of hydroxyl groups at the surface may be obtained from measurements of water vapor adsorption, water being very specific toward the silica surface condition. It is also shown that the sorbitivity of both aerosyl and quartz suffers an abrupt decrease after irradiation. These mechanisms may be explained by the interaction between a gamma photon and a silanol group which leads to the formation of free radicals. (N.W.R.)

5252 ON THE RECOMBINATION OF RADICALS IN THE CONDENSED PHASE. Ya. S. Lebedev, V. K. Ermolaev (Ermolayev), Yu. D. Tzvetkov, Yu. N. Molin, N. Ya. Buben, and V. V. Voevodskii (Voevodsky). 11p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

An electron spin resonance technique is used for studying the recombination of free radicals formed in various organic substances and crystalline polymers by irradiation. The study shows that the free radical recombination in the condensed phase is a process closely related to phase transitions in the substance structure. Analysis of recombination kinetics shows that the activation energy decreases with increasing temperature. Apparently the recombination of radicals in the condensed phase is a cooperative process accounted for by over-all system properties, and not those of individual particles. The recombination constants and rates are tabularly presented for various organic substances and crystalline polymers. (N.W.R.)

5253 RADIATION INDUCED FREE RADICALS IN CARBOHYDRATES AND AN ESTIMATION OF THEIR CONCENTRATION. G. Loefroth, L. Ehrenberg, and A. Ehrenberg (Karolinska Institutet, Stockholm and Universitet, Stockholm). 6p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

An investigation is made in order to gain knowledge about the stability and concentration of the radicals in irradiated carbohydrates. The electron spin resonance spectra obtained for each carbohydrate is different indicating an influence of different crystal surroundings on the trapped radicals and variations in the chemical nature of the radicals. A broadening of the lines is appreciable even at doses of 0.5 Mrad. Although there are differences in each carbohydrate due to the effects of storage and heat treatment, the effects appear to be in the same direction and of about of the same magnitude. Results are given for several carbohydrates both in graphical and tabular form. (N.W.R.)

5254 TRANSIENT KINETICS OF FREE RADICALS PRODUCED BY HIGH ENERGY RADIATION. R. L. McCarthy and A. MacLachlan (E. I. du Pont de Nemours & Co., Wilmington, Del.). 16p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

When pure cyclohexanol is irradiated with high-energy electrons, a transient optical absorption is observed in the region 2900 to 3400 Å. When cyclohexane is saturated with oxygen, a strong transient absorption is observed extending from approximately 2700 to 3200 Å. Thus the transient decay of the optical absorption of the free radicals is recorded. Together with the measured radical concentration determined from end-product analysis this provides a direct measure of the absolute reaction rate constant. For the dimerization of the radicals derived from cyclohexanol this value (3.4×10^8 l/mole-sec) is shown to be equal to the calculated bimolecular diffusion-controlled rate constant. The bimolecular reaction of cyclohexyl peroxy radicals has a rate constant of 2×10^6 l/mole-sec, which is 10^{-4} times the diffusion-controlled rate constant. Measurements of this rate constant as a function of temperature show that the activation energy for this reaction is zero (less than 1 kcal/mole), thus a severe steric hinderance to the reaction is indicated. The reaction of cyclohexyl peroxy radicals with HO_2 radicals is implied in the data. The extinction coefficients for the cyclohexanol radical and the cyclohexyl peroxy radical are calculated. (N.W.R.)

5255 ESR INVESTIGATIONS ON ENERGY TRANSFER IN RADIOLYSIS OF ORGANIC SUBSTANCES. N. Ya. Buben, I. I. Chkheidze, A. T. Koritzkii (Koritzky), Yu. N. Molin, V. N. Shamshev, and V. V. Voevodskii (Voevodsky). 10p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

The electron spin resonance method opens up possibilities for explaining the role of energy transfer through organic substances at initial stages of radiolysis, as it makes possible the recording of the primary act of bond scission and radical formation without the complications caused by secondary reactions. The method gives information of two kinds. First, the spectrum often shows the site of bond scission in complex molecules or compounds, and energy transfer may thus be followed. Second, the radical yield, G, may be determined from the kinetics of radical accumulation. Variations in G caused by the introduction of some groups into the complex molecule, or by addition of foreign molecules to the initial chemical compound would also provide evidence on energy transfer through organic substances. Results of hydrocarbon compounds are presented. (N.W.R.)

5256 INFLUENCE OF γ-RADIATION ON ALIPHATIC POLYESTERS. A. Orszagh, H. Czarnodola, Z. Górska, and J. Zurakowska-Orszagh. 7p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In French)

A study was made of the influence of gamma radiation on a series of aliphatic polyesters of the general formula $HO(-/CH_2/_nOOC/CH_2/_m-)_xCOOH$, where n = 2, 3, and 10 and m = 4, 7, and 8. In this series there are polyesters made up of diols and dibasic acids having an even and odd number of CH_2 groups, and also mixed polyesters made up of even diols and uneven acids and vice versa. Relations are graphically shown between the irradiation time and the intrinsic viscosity of the polyesters and the irradiation time and the carboxylic group concentration. From these relations one sees that in general the intrinsic viscosity decreases with an increase of the irradiation dose. If one agitates the polyesters made-up of even diols and odd acids, the stability is improved with the increase of paraffin chains among the ester groups in the polymeric chain. The concentration of the carboxylic groups is increased proportionally from the doses. (N.W.R.)

5257 FACTORS CONTROLLING RADIATION-INDUCED FREE RADICALS IN A BIOLOGICAL SYSTEM. E. L. Powers (Argonne National Lab., Ill.), B. Smaller, C. A. Tobias, and John Lyman. 1p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

Studies on the x-irradiated dried spores of the bacterium *Bacillus megaterium* have shown that free radicals produced in cells by high energy radiation (20 kev) are responsible for a portion of the biological effects of irradiation. Parallel physical studies on radical production in these spores with an electron paramagnetic resonance spectrometer have shown at least two general kinds of radicals produced by these x rays. One of these is indicated by a doublet with approximately 20 gauss spacing and the other by a triplet with approximately 30 gauss spacing. Hence, by exposing the anoxically irradiated spore to agents such as nitric oxide and sulfide, it is shown that approximately 50% of the anoxic response to radiation might be ascribed to free radicals that become damaging when combined with oxygen. Furthermore, dried spores exposed to high temperature lose these free radicals before they become toxic. The behavior of these radicals toward heat and toward nitric oxide appears to be about the same, while hydrogen sulfide appears to be slightly more efficient as a radical remover. (N.W.R.)

5258 SPECTRA PRODUCED BY ELECTRON BOMBARDMENT OF HYDROCARBON-RARE GAS SOLIDS; A NEW TRANSITION OF THE C_2 MOLECULE. L. J. Schoen (National Bureau of Standards, Washington, D. C.). 4p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

The emission from hydrocarbon–rare gas solids during electron bombardment at 4.2 and 20.4°K is described. The hydrocarbons employed in argon, krypton, and xenon matrices are limited to methane, ethane, and propane. These hydrocarbons are found to lead to identical spectra. Using the isotopic substitution method, two electronic band systems of the C_2 molecule are identified. The first of these, the Swan bands ($^3\pi_g \rightarrow {}^3\pi_u$) are observed both in emission and absorption at 4.2 and 20.4°K. The second band system appears to be due to a new transition of C_2 not reported in any previous gas or solid phase work. Its relationship to the Swan bands and the magnitude of the isotope shifts occurring on carbon-13 substitution suggest that it arises from the ($^3\pi_g \rightarrow {}^1\Sigma_g^+$) transition of the C_2 molecule. (N.W.R.)

5259 FREE RADICAL SPECIES PRODUCED BY RADIATION IN H_2O AND H_2O_2 AT LOW TEMPERATURES. Bernard Smaller and Juan McMillan (Argonne National Lab., Ill.). 3p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

A study is made of the free radicals produced at 77°K in single crystals of ice and hydrogen peroxide by ionizing and ultraviolet radiation. The radicals are detected by the electron paramagnetic resonance technique using equipment operating at 9.1 kMc/sec and double-field modulation for increased resolution. Results show that the symmetry around the O–H bonding in ice is accounted for by rapid rotation of the radical around the axis. In hydrogen peroxide the spectra are quite complex containing at least seven separate components. The kinetics of the reactions are shown. Radical migration through the lattice for the HO_2 radical is considered in terms of proton transfer with stabilization occurring at an impurity site, such as oxygen. (N.W.R.)

5260 ELECTRON SPIN RESONANCE OF FREE RADICALS PRODUCED BY IRRADIATION OF HYDROGEN PEROXIDE–WATER SOLUTIONS AT 90°K. Robert C. Smith and S. J. Wyard (Guy's Hospital Medical School, London). 9p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

The electron spin resonance of the free radical produced by irradiation of hydrogen peroxide–water solutions is studied in order to find its identity and its mode of production under various conditions. The studies at 90°K show that the radical is characterized by $g_{11} \simeq 2.03$ and $g_{1} \simeq 2.00$, and with a doublet hyperfine splitting of 13 gauss. The radical is investigated by the basic electron spin resonance spectrum, local distribution of radicals, radical yields, and ultraviolet spectroscopy. From the study, it is concluded that the radical is probably HO_2 since this radical would be expected to show hyperfine splitting due to the single proton. (N.W.R.)

5261 STUDIES OF TRAPPED RADICALS AT LIQUID HELIUM TEMPERATURES BY CARBON RESISTANCE THERMOMETRY. Maurice W. Windsor (Space Technology Labs. Inc., Los Angeles). 15p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

Spontaneous, repetitive temperature and pressure pulses are observed during the deposition of discharged hydrogen on a liquid helium cooled surface. The pulses cease when the discharge is quenched. Similar behavior occurs for discharged deuterium and discharged nitrogen. Very similar pulses occur with undischarged hydrogen containing a few percent of some impurity such as water vapor, carbon dioxide, or even neon. No pulses occur with the pure dried gas. Although the detailed behavior varies with the particular gas mixture and the flow rate and temperature, the following observations can be made. The pulses are of short duration and are a function of the thermal conductivity and thermal capacity of the substrate. Pulse energies exceeding 10^5 microjoules are measured for discharged nitrogen. At the other extreme, energies below 100 microjoules are observed for hydrogen containing small amounts of impurities. Coincident pressure pulses indicate that a portion of the deposit is thrown back into the vapor phase with each release of energy. However, experiments in which visual observation is possible show that the major portion of the deposit remained intact. Thus, the results show that the thermal conductivity of a solid at liquid helium temperature is a very sensitive function of its state of crystalline order. At these temperatures, scattering of phonons by defects in the crystal lattice and grain boundaries can reduce the thermal conductivity by several orders of magnitude. Because of the poor thermal conductivity of the deposited solid, achievement of maximum concentrations of trapped atoms would appear to require cooling the incoming gas to as low a temperature as possible and using a very slow rate of deposition in order to minimize temperature gradients in the condensed material. (N.W.R.)

5262 FREE RADICALS IN THE CHAIN REACTION OF γ-RADIATION INDUCED REDUCTION OF OXYGEN. Z. P. Zagórski (Inst. of Nuclear Research, Warsaw). 7p. of "The Fifth International Symposium on Free Radicals." Stockholm, Almqvist & Wiksell, [1961]. (In English)

A polarographic method is used for studying the radical mechanism in the chain reaction of gamma irradiated $NaOH-Na_2SO_3-O_2$ systems. First results show that the radiation induced oxidation of sulfite by oxygen gives enormous radiation yields indicating, together with other features, that it behaves like a typical chain reaction. The reaction stops after the removal of gamma radiation, showing a small postirradiation effect. The polarographic data on O_2 and the solubility data in different solutions show that oxygen exists in the solution as O_2 and that no interaction like hydration needs to be taken into account. The same applied to SO_3^{2-} ion. From all the facts obtained, the following radical mechanism is proposed. It is assumed, that the main intermediate reaction, following the $H_2O \rightarrow H + OH$ reaction, is $H + O_2 \rightarrow HO_2$. Two reactions of SO_3^{2-} may take place: $SO_3^{2-} + O_2H \rightarrow SO_4^{2-} + OH$ and $SO_3^{2-} + OH \rightarrow SO_4^{2-} + H$. For the termination step the reaction $H + H \rightarrow H_2$ is postulated. The free radical mechanism is based on the Magee model of the primary effects in irradiated water. (N. W. R.)

Analytical Procedures

5263 (APEX-169) DETERMINATION OF URANIUM IN 310 STAINLESS STEEL RIBBON-TYPE FUEL ELEMENT BY THE APPLICATION OF THE MERCURY CATHODE–LEAD REDUCTOR–POTASSIUM DICHROMATE METHOD. Raymond A. Dunleavy, Anna M. Bartruff, and Mary R. Menke (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 18, 1954. Decl. June 16, 1961. 15p. Contract [AT(11-1)-171].

A simple, accurate method for the determination of the uranium content of 310 stainless steel ribbon-type fuel elements was developed. The sample is dissolved in a sulfuric and nitric acid solution, evaporated to fumes of sulfur trioxide, and then diluted with water. Interfering ions are removed by electrolysis in a Melaven-type, water jacketed, mercury cathode cell. The percentage of uranium is then determined by reducing the uranium in sulfuric-hydrochloric acid solution with a lead reductor, adding ferric chloride to the reduction solution, and titrating the resulting ferrous ion with standard dichromate. Diphenylamine sulfonate is used as the indicator. Statistical treatment of data obtained from the analysis of synthetic samples shows the standard deviation for the method to be 0.055% uranium dioxide. (auth)

5264 (APEX-170) DETERMINATION OF URANIUM IN THE 310 STAINLESS STEEL RIBBON-TYPE FUEL

ELEMENT BY THE APPLICATION OF THE MERCURY CATHODE–LEAD REDUCTOR–CERIC SULFATE METHOD. Raymond A. Dunleavy, Gilbert L. Contner, and John H. Sweet (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 18, 1954. Decl. June 16, 1961. 10p. Contract [AT(11-1)-171].

The mercury cathode–lead reductor–potassium dichromate method previously used for the determination of uranium in 310 stainless steel ribbon-type fuel elements was improved. The sample is dissolved in perchloric acid, electrolyzed in a mercury cathode cell, and reduced by a lead reductor. The resulting tetravalent uranium is then titrated with standard ceric sulfate, using ferroin as the indicator. By employing this method, the over-all time of analysis was reduced by approximately four hours, and the precision of the determination was increased from a standard deviation of 0.055% to a standard deviation of 0.029% uranium dioxide. (auth)

5265 (CF-60-11-124(Rev.)) RADIOACTIVATION ANALYSIS. G. W. Leddicotte (Oak Ridge National Lab., Tenn.). Sept. 22, 1961. Contract [W-7405-eng-26]. 43p.

The development of nuclear reactors and other sources of nuclear particles has provided the means for development of radioactivation analysis which has been successfully applied to the determination of microgram and even submicrogram quantities of many elements. Nuclear reaction involving a variety of nuclear particles—alpha particles, deuterons, neutrons—and also gamma radiation and photons can be used in radioactivation analysis. However, the neutron reactions have been used most extensively in activation analysis. The most useful of the neutron reactions, the n,γ reaction, involves the capture of a neutron by a stable nucleus to produce a radioisotope of the original atom. Nuclear reactors are prolific sources of neutrons for producing n,γ reactions. Through their use, therefore, it has been possible to apply radioactivation analysis in many instances where an analytical method of great sensitivity and specificity was required. The techniques used in radioactivation analysis are described and the limits of measurement and general applications of the method are discussed. (auth)

5266 (DP-648) SPECTROCHEMICAL METHODS FOR ANALYSIS OF PROCESS SOLUTIONS. Douglas H. Purcell and J. Allen Wheat (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1961. Contract AT(07-2)-1. 10p.

Aluminum, Zirconium, molybdenum and uranium were determined spectrochemically in simulated dissolver solutions, after conversion to a sulfate solution. The coefficient of variation ranged from 7 to 13% except for uranium, for which it was 35%. Existing methods for the spectrochemical determination of fluoride were modified so as to be applicable to the analysis of dissolver solutions. The coefficient of variation for fluoride was less than 30% at 0.01 and 0.1 M concentrations. (auth)

5267 (MAB-178-M) REPORT OF THE SUBPANEL ON ANALYTICAL TECHNIQUES. REFRACTORY METALS SHEET ROLLING PANEL. (National Research Council. Materials Advisory Board). Nov. 1961. 79p.

The subpanel on Analytical Techniques was formed to survey methods of analysis for refractory metals and alloys to determine whether satisfactory and precise analytical techniques exist for the alloy classes of current interest. Surveys of producers and users of refractory metals were carried out and it was concluded that analytical techniques are probably adequate. It is also noted that steps should be taken to see that analytical programs are complete; reference samples should be procured. (J.R.D.)

5268 (TID-14328) ELECTROCHEMISTRY IN ANHYDROUS ETHYLENEDIAMINE EFFECTS ON SALTS AND SOLVENT IN POTENTIOMETRY AND POLAROGRAPHY. Ward B. Schaap, Richard E. Bayer, Joseph R. Siefker, Joon Yong Kim, Philip W. Brewster, and Frederic C. Schmidt (Indiana. Univ., Bloomington). [1961]. Contract [AT(11-1)-256]. 34p.

The greater basicity, including coordinating ability, and the lower dielectric constant of ethylenediamine serve to distinguish it from water as a solvent medium and as a medium for electrochemistry. The lower dielectric constant increases both the longer-range interionic attractions and the extent of ion-pair association. Recent conductance studies providing ion-pair constants are summarized. The effects of ion-pairing on equilibria involving single electrolytes and mixtures of electrolytes are considered in detail and the results applied to various phenomena associated with potentiometric titrations and polarography in ethylenediamine. Indicator and reference electrodes used in ethylenediamine are surveyed and a new reference electrode suitable for potentiometric and polarographic use is described. (auth)

5269 (WAL-TR-823/2) ION EXCHANGE PHOTOMETRIC DETERMINATION OF TANTALUM IN VANADIUM ALLOYS. Thomas A. Ferraro, Jr. (Watertown Arsenal Labs., Mass.). Dec. 1961. 16p.

A method was developed for the determination of tantalum in vanadium alloys. Tantalum was determined photometrically with pyrogallic acid following a separation by ion exchange. A detailed procedure is given. (auth)

5270 (WAPD-T-1221) ANALYSIS OF URANIUM DIOXIDE CERAMIC FUEL MATERIALS FOR THE SHIPPINGPORT PRESSURIZED WATER REACTOR. R. M. Burd, C. F. Lentz, R. M. Jacobs, and G. W. Goward (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1960. Contract AT(11-1)-Gen-14. 19p.

Presented at Fourth Conference on Analytical Chemistry in Nuclear Reactor Technology and First Conference on Nuclear Reactor Chemistry, October 12–14, 1960.

Chemical analysis of the original blanket material and the replacement blanket of the Shippingport Pressurized Water Reactor is described. The blanket fuel component consisted of natural uranium dioxide pellets encased in a zircaloy-2 tube. The analytical control phase of the preparation of pellets centered about two main fields: determining the exact composition of the uranium oxide and determining the amounts of various impurities present. The determination of the exact composition of the uranium oxide is accomplished by two methods: volumetric determination of the total uranium content and polarographic determination of the uranium(VI) content. The impurity elements which were analyzed by wet chemical techniques include Al, B, Cd, Cr, Cu, F, Fe, Mo, Ni, and Si. (M.C.G.)

5271 (CEA-tr-A-978) METHODE TRES SENSIBLE POUR LA CARACTERISATION DU FLUOR. (Very Sensitive Method for Fluorine Evaluation). K. Machner. Translated into French from Z. Anal. Chem., 162: 6(1958). 4p.

The laboratory procedure for the colorimetric determination of fluorine with aluminum chromazurol S is given, and the methods for the preparation of the reagents used are described. (J.S.R.)

5272 A RADIOCHEMICAL DETERMINATION OF ALPHA EXPOSURE FROM ENRICHED URANIUM IN URINE. John S. Alercio, George A. Welford, and Robert S. Morse (U. S. Atomic Energy Commission, New York). Am. Ind. Hyg. Assoc. J., 22: 443-7(Dec. 1961).

A method is described for the separation and measurement of alpha activity from enriched uranium in urine. The uranium is collected by an alkaline phosphate precipitation and is isolated from urine constituents through ion exchange. The resulting solution is measured fluorimetrically for uranium and then electroplated for alpha count. Self absorption of the alpha particles is minimized by the preliminary ion exchange separation and by an improved electrodeposition technique. Fluorimetric recovery of added uranium from one liter of urine is approximately 95% ± 10%. The recovery by alpha count is 92% ± 10%. (auth)

5273 SEPARATION OF THE ALKALI METAL CATIONS FROM MIXTURES OF VARIOUS CATIONS BY ELECTROCHROMATOGRAPHY. Joseph Sherma and Harold H. Strain (Argonne National Lab., Ill.). Anal. Chem., 34: 76-80(Jan. 1962).

Differential electrical migration in an ammoniacal solution of ammonia–triacetic acid containing cyanide facilitates the separation and estimation of the alkali metal ions from other univalent ions (silver, thallium, and mercurous) and from all multivalent ions as well. Migration from this aqueous solution into and through a nitromethane solution provides for the separation of the alkali metal ions from one another as well as from the mixture. All the separated alkali metal ions may be located and estimated by flame photometry. Sodium, potassium, rubidium, and cesium may be detected and estimated by neutron activation followed by gamma-ray spectrometry. (auth)

5274 SPECTROGRAPHIC DETERMINATION OF THORIUM IN URANIUM ORE. Roy Ko and M. R. Weiler (General Electric Co., Richland, Wash.). Anal. Chem., 34: 85-7(Jan. 1961).

Thorium in uranium ores was separated and purified by lanthanum fluoride precipitation and TTA extraction. After the purification, zirconium internal standard was added and the thorium determined by emission spectrometry. Successful determinations were made on 1 gram of uranium ore containing as little as 0.1 ppm of thorium with an average Th^{234} tracer recovery of 85%. The precision of the method expressed as a relative standard deviation was ±12% at the 1 ppm level. (P.C.H.)

5275 RADIOCHEMICAL DETERMINATION OF RUTHENIUM BY SOLVENT EXTRACTION AND PREPARATION OF CARRIER-FREE RUTHENIUM ACTIVITY. Jesse W. T. Meadows and George M. Matlack (Los Alamos Scientific Lab., N. Mex.). Anal. Chem., 34: 89-91(Jan. 1962).

Essentially quantitative extraction of ruthenium tetroxide by carbon tetrachloride from aqueous solutions at pH 4 forms the basis for a method for determining fission product ruthenium in neutron-irradiated plutonium. In the presence of zirconium holdback carrier, ruthenium is freed from all other fission products by a single extraction. The ruthenium is then back-extracted into dilute sodium hydroxide, precipitated as mixed oxides, mounted in a suitable manner, and beta or gamma counted. The extraction method is as precise as and more rapid than the conventional distillation method. This procedure may also be used for the preparation of carrier-free ruthenium activity. (auth)

5276 DETERMINATION OF SMALL AMOUNTS OF COBALT BY ISOTOPE DILUTION ANALYSIS. William D. Ralph, Jr., Thomas R. Sweet, and Inara Mencis (Ohio State Univ., Columbus). Anal. Chem., 34: 92-4(Jan. 1962).

Isotope dilution analysis is combined with solvent extraction and spectrophotometry to produce an effective general method for the determination of constituents that are not extracted quantitatively. Combining isotope dilution with extraction of the cobalt–2-nitroso-1-naphthol complex into chloroform results in an accurate and reliable method for the determination of small amounts of cobalt in alloys of high copper content and in ingot irons. Co^{60} is used as a radioactive tracer. (auth)

5277 SPECTROPHOTOMETRIC DETERMINATION OF RUTHENIUM WITH 2-NITROSO-1-NAPHTHOL. D. L. Manning and Oscar Menis (Oak Ridge National Lab., Tenn.). Anal. Chem., 34: 94-6(Jan. 1962).

A sensitive spectrophotometric method for the determination of ruthenium is based on the color reaction of ruthenium with 2-nitroso-1-naphthol in 3M hydrochloric acid saturated with sulfur dioxide. The colored species exhibits maximum absorbance of 600 mμ. Simple salts of ruthenium such as ruthenium chloride can be determined in the presence of uranium without a prior separation. Beer's law is obeyed over the concentration range, 1 to 10 μg Ru per ml. The relative standard deviation is about 5%. The molar absorptivity of the colored species is approximately 6500. (auth)

5278 DETERMINATION OF SODIUM IN SILICATE MINERALS AND ROCKS BY NEUTRON ACTIVATION ANALYSIS. Gerald L. Schroeder and John W. Winchester (Massachusetts Inst. of Tech., Cambridge). Anal. Chem., 34: 96-9(Jan. 1962).

A procedure is described for the determination of sodium in natural silicate minerals by pile neutron activation and counting the induced γ radiation in the irradiated specimen without chemical processing. An integral scintillation counter set to accept all γ-rays with energies above 2.6 Mev is used for radioactivity measurement. Precision and absolute accuracy of the method are of the order of 1 to 2%, and interference by trace elements is virtually negligible. Results are presented for the analysis of the standard granite G-1, diabase W-1, argillaceous limestone NBS 1a, and flint clay NBS 97. (auth)

5279 TITRATION OF URANIUM WITH POTASSIUM DICHROMATE. DETERMINATION OF DISPROPORTIONALITY EFFECTS. Jorge E. A. Toni (Atomic Energy Commission, Buenos Aires). Anal. Chem., 34: 99-102(Jan. 1962).

The indicator, diphenylaminesulfonic acid, is shown to be responsible for the disproportionality observed between milligrams of uranium titrated and milliliters of potassium dichromate used, when the titration end point is determined visually. Determining the end point potentiometrically, the discrepancy was eliminated within certain limits. The effect of some variables on the indicator was studied and optimum conditions were found for the potentiometric titration of as little as 10 mg of uranium. (auth)

5280 VOLUMETRIC DETERMINATION OF URANIUM IN THE PRESENCE OF NIOBIUM UTILIZING A BISMUTH METAL REDUCTOR. Raymond J. Jaworowski and William D. Bratton (Pratt and Whitney Aircraft, CANEL, Middletown, Conn.). Anal. Chem., 34: 111-12(Jan. 1962).

The use of bismuth metal as a reducing agent during the determination of uranium in the presence of large amounts of niobium was studied. Other metals or metal amalgams reduce both uranium and niobium, prohibiting a simple volumetric determination. When a strongly acid solution of uranium and niobium is passed through a column of bismuth metal, the uranium(VI) is quantitatively reduced to uranium(IV) with no uranium(III) or niobium(III) being formed and without encountering the problem of niobium hydrolysis. The uranium is determined indirectly by reaction with excess iron(III), producing iron(II) which is titrated with standard cerium(IV) solution. The end point of the titration is determined potentiometrically. Interferences were encountered with iron, molybdenum, vanadium, and tungsten in mixtures of uranium and niobium but not with nickel, zirconium, chromium, beryllium, copper, titanium, and aluminum. (auth)

5281 IDENTIFICATION OF PRECIPITATES IN DIFFUSION ZONES USING THE ELECTRON PROBE MICROANALYZER. R. E. Seebold and L. S. Birks (U. S. Naval Research Lab., Washington, D. C.). Anal Chem., 34: 112-16(Jan. 1962).

With the electron probe microanalyzer it is possible to identify and analyze individual precipitates and determine which impurity element is responsible for the interaction when small precipitates form in intermetallic diffusion zones due to interaction with impurities such as carbon, nitrogen, oxygen, phosphorus, or sulfur contained in the parent metals. When iron of the same quality was diffused in one case with niobium and another case with chromium, the precipitates formed in the iron were Nb_2S_5 for the Nb–Fe system and CrN_2 or Cr_2N_5 for the Cr–Fe system. This indicates that impurity activity varies with the diffusing metal atoms. (auth)

5282 X-RAY METHOD FOR DETERMINING LIQUID DENSITIES AT HIGH TEMPERATURES AND PRESSURES. N. A. Krohn and R. G. Wymer (Oak Ridge National Lab., Tenn.). Anal. Chem., 34: 121-3(Jan. 1962).

A method for measuring liquid densities at high temperatures and pressures is based on x-ray determinations of the position of the liquid-vapor interface in a calibrated pressure vessel. Densities of a 35.2% uranyl sulfate solution were measured from room temperature to 300°C as a demonstration of the method. (auth)

5283 RAPID, AUTOMATIC X-RAY ANALYSIS OF MAGNESIUM ALLOYS. Graham A. Stoner (Dow Chemical Co., Midland, Mich.). Anal. Chem., 34: 123-6(Jan. 1962).

An automatic, direct, rapid, and accurate x-ray fluorescence method is described for the determination of zirconium, zinc, thorium, cerium, neodymium, praseodymium, and lanthanum in magnesium alloys. The Norelco Autrometer is used as the x-ray unit. This technique is ideally suited for production control and provides an analysis with an accuracy comparable to existing chemical and spectrographic methods. (auth)

5284 PYROLYTIC SEPARATION OF RUTHENIUM. Oscar Menis and R. H. Powell (Oak Ridge National Lab., Tenn.). Anal. Chem., 34: 166-7(Jan. 1962).

Ruthenium was separated from solutions of uranyl sulfate by pyrolysis. Fusion pyrolysis at 1000°C, utilizing a sodium bismuthate flux coupled with a sweep of moist oxygen, converted microgram quantities of ruthenium as the complex nitroso compounds to the volatile tetroxide, RuO_4. A fused silica boat was used to contain the sample and flux, otherwise a creeping of the flux occurs. The stream of moist oxygen carries the volatilized RuO_4, formed in the flux, to a trap of 3 $\underline{N}$ HCl saturated with SO_2 where it is removed from the gas stream. Over the range of about 20 to 200 μg of ruthenium, an average recovery of 95% was realized with a relative standard deviation of approximately 13%. (P.C.H.)

5285 THE ISOTOPIC ANALYSIS OF NITROGEN BY THE METHOD OF ELECTRON PARAMAGNETIC RESONANCE. O. L. Lebedev, M. L. Khidekel, and G. A. Razuvaev (Gorkii State Univ., USSR and Gorkii Polytechnic Inst., USSR). Doklady Akad. Nauk S.S.S.R., 140: 1327-9 (Oct. 21, 1961). (In Russian)

The concentration of a stable nitrogen radical such as 2, 2, 6, 6-tetra-methyl-N-piperidone-4-oxide-1 (I) is measured by electron paramagnetic resonance. The nitrogen sample is converted to ammonia by the usual methods, and the NH_3 is incorporated into radical (I). Since the magnetic moments of N^{14} and N^{15} differ by $\frac{1}{2}$ of a unit (1 and $\frac{1}{2}$ respectively), there are three spectral lines for N^{14} and two lines for N^{15}. The determination of the N^{14} and N^{15} content can be made by comparing the areas under the doublet and triplet sections of the spectra. A standard is not required. Samples containing 28.0, 25.2 and 19.8% N^{15} was found to have 27.9, 25.0 and 18.9% N^{15} respectively by this method. The measurements were carried out in water-alcohol mixtures in air at room temperature. A change in concentration of the ammonium salt by a factor of 10 during the synthesis of radical (I) does not affect the accuracy of the determination. As low as 0.02 mg of the nitrogen-containing compound can be used for analysis. (TTT)

5286 ALLOY COMPOSITION ANALYSIS USING RADIOISOTOPE-EXCITED X-RAYS. C. A. Ziegler and J. C. McCue (Tracerlab Inc., Waltham, Mass.). Intern. J. Appl. Radiation and Isotopes, 12: 1-5(Nov. 1961). (In English)

The non-destructive measurement of the weight per cent concentration of uranium in aluminum–uranium alloy is described. A technique is employed which utilizes beta excitation to generate the desired source of x radiation. Of major significance is the utilization of a cheap and relatively safe gaseous radioisotope, krypton-85, in a convenient solid state. Analysis is performed by measuring the combined Rayleigh scattered and fluorescence x-ray flux from uranium. The determination is not dependent on uranium enrichment. Small sampling volumes ($\frac{1}{4}$ cm^3) may be analyzed in 3 min periods with a measurement accuracy of less than ±1 per cent error. The use of a radioisotopic source enables the apparatus to produce stable irradiation flux at low cost. Instrumentation and equipment requirements are not elaborate, thus the technique lends itself readily to process applications, particularly where portability is desired. (auth)

5287 THE ACCURACY OF ISOTOPE DILUTION METHODS. H. Weiler (Ian Clunies Ross Animal Research Lab., Prospect, N. S. W., Australia). Intern. J. Appl. Radiation and Isotopes, 12: 49-52(Nov. 1961). (In English)

The accuracy of quantitative analyses by various isotope dilution methods is discussed. The most favorable amounts of dilution are derived under the assumption that the relative error, $\delta S/S$, in measuring a specific activity, S, is independent of S. (auth)

5288 THE DETERMINATION OF COPPER BY RADIOACTIVATION. G. Leliaert and D. Decat (Centre d'Etudes de l'Energie Nucléaire, Mol-Donk, Belg.). Intern. J. Appl. Radiation and Isotopes, 12: 63-4(Nov. 1961). (In English)

Trace amounts of copper may be determined in irradiated cobalt and germanium by direct colorimetry with neocuproin. In cobalt-containing materials, an error is introduced due to the flux depression in the sample, however this error is taken into account with a correction factor. The analytical procedure is described for extracting the copper with neocuproin in chloroform and measuring the obtained copper-64 activity. Results are presented for several irradiated samples. (N.W.R.)

5289 RAPID DETERMINATION OF TETRAVALENT URANIUM IN URANIUM TETRAFLUORIDE. Kenji Motojima, Hiroshi Hashitani, and Kazuo Katsuyama (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 855-7(Nov. 1961). (In Japanese)

A rapid and accurate analytical method is proposed for the titrimetric determination of U(IV) in uranium tetrafluoride. A sample weighing about 600 mg is treated with 10 ml of aluminum sulfate (2m)-sulfuric acid (6m) mixture and exactly 50 ml of 0.1 n potassium dichromate solution. By heating to 80°C for 10 to 20 min, the sample is dissolved thoroughly. The remaining Cr(VI) is then titrated with a ferrous ammonium sulfate standard solution using sodium diphenylamine sulfonic acid as an indicator. The dissolution of the sample is rapid and the reproducibility of the result obtained is very good. (auth)

5290 SPECTRA OF RUTHENATES AND PERRUTHENATES. J. L. Woodhead and J. M. Fletcher (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Chem. Soc., 5039-41(Nov. 1961).

The molar extinction coefficients of ruthenate and perruthenate ions are redetermined at 317, 385, and 460 mμ (isosbestic points). From the values obtained, ruthenium is more easily determined in many of its complexes when it is converted to ruthenate by oxidation and determined by the optical densities obtained by using the values of the molar extinction coefficients. The estimation of ruthenium is even more reliable when the solution is converted with persulfate into a mixture of ruthenate and perruthenate. (N.W.R.)

5291 NEUTRON MEASUREMENT OF SURFACE SOIL MOISTURE. C. H. M. van Bavel (U. S. Water Conservation Lab., Tempe, Ariz.). J. Geophys. Research, 66: 4193-8 (Dec. 1961).

A neutron probe design for the measurement of surface soil moisture is described. The probe consists of a single BF_3 tube, a Ra–Be source in a gamma shield and a plastic shield which serves also as a standard. Adequate accuracy and sensitivity are reported when surface soil is homogeneous. When surface soil is stratified the interpretation of measurements is uncertain. (auth)

5292 PHYSICS AND TECHNOLOGY OF MASS SPECTROSCOPIC ANALYSIS. PART VI. Hans Voshage (Max-Planck-Institut für Chemie, Mainz). Kerntechnik, 3: 492-7 (Nov. 1961). (In German)

The preceding parts treated the physical principles and some technical details of the individual functions effective in the mass spectrometer (ion production, electromagnetic mass analysis of the ion, and ion detection). This part presents a survey of the harmonization of all individual functions during the most important applications of mass spectrometric gas analysis. (auth)

5293 COLORIMETRIC DETERMINATION OF Ti IN Al AND Mg USING DRANTIPYRILMETHANE. V. A. Zinchenko and S. I. Rudina (All-Union Inst. of Scientific Research of Aluminum and Magnesium, USSR). Zavodskaya Lab., 27: 956-8(1961). (In Russian)

A colorimetric method using diantipyrilmethane was used for determining 10^{-4} to 5×10^{-4}% of Ti in pure metals. The method proved to be more accurate than the hydrogen peroxide method. Descriptions are given of two variations, one with preliminary separation of Ti and the other with separation in the collector. (tr-auth)

5294 MASS SPECTROMETRIC METHOD FOR ANALYSIS OF PURE MATERIALS. M. S. Chupakin and Yu. M. Miller. Zavodskaya Lab., 27: 1009-12(1961). (In Russian)

Various methods for determining small admixtures are described. The performance of a double-focusing mass spectrometer with a sparking ion source, capable of analyzing a large number of elements with a sensitivity of 10^{-7} to 10^{-6} at. %, is described. A method of thermionic emission is suggested for elements with low ionization potential. The sensitivity of the method is 10^{-14}%. (tr-auth)

5295 DETERMINATION OF RHENIUM IN WATERS BY ADSORPTION. V. V. Rodzaevskii and A. I. Lazarev (Balkhash Mining and Metallurgical Plant, USSR). Zavodskaya Lab., 27: 1203-6(1961). (In Russian)

Small quantities of rhenium are concentrated by sorption on activated coal saturated with methyl blue. The same method is used for separating rhenium from W and Mo. (tr-auth)

5296 RADIOACTIVATION ANALYSIS FOR DETERMINING MICROADMIXTURES IN SEMICONDUCTORS. R. S. Rychkov and N. A. Glukhareva. Zavodskaya Lab., 27: 1246-50(1961). (In Russian)

An activation method for determining Ge, Si, SiO, SiC, $SiCl_4$, Al, C, and GaAs contents of Au, Cu, Sb, Zn, and other admixtures was developed. The method is useful in cases when the quantitative analysis of admixture in cumbersome. The analysis requires from 30 to 40 hours. The sensitivity ranges from 5×10^{-5} for S to 2×10^{-11} for Au. (tr-auth)

5297 EMISSIONNYI SPEKTRAL'NYI ANALIZ ATOMNYKH MATERIALOV. (Emission Spectral Analysis of Nuclear Materials). A. N. Zaidel, N. I. Kaliteevskii, L. V. Lipis, and M. P. Chaika—A. N. Zaidelya, ed. Moscow, State Publishing House of Physics-Mathematical Literature, 1960. 686p.

Systemized data are given on the method of spectral analysis of pure materials, in particular the materials used in nuclear reactors. The book is divided into three parts. The first part deals with the principles and apparatus of spectral analysis. The second part examines various methods of spectral analysis, considering simple analysis of elements with complex spectra, fractional distillation, evaporation, chemical enrichment of specimens, and determination of rare earth elements. The third part covers spectral analysis of isotopic composition. An appendix includes data on the melting and boiling points of some elements and their oxides and methods of developing and reading spectrograms. Each part gives an extensive list of references. (R.V.J.)

General Inorganic and Physical Chemistry

5298 (APEX-531) BERYLLIUM OXIDE HYDROLYSIS. M. E. Lapides, R. J. Spera, M. J. Mullikin, and J. H. King (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 1956. Decl. June 16, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 26p.

A compilation of information concerning beryllium oxide hydrolysis problems is presented. A summary of system equilibrium and corrosion kinetics is given. An assessment was made of consistency and engineering utility of experimental deposition tests. It was concluded that the test device used is satisfactory for screening purposes and for illustrating general effects of temperature level and moisture contents. Fair correlation of test results was obtained by present methods, but both the uncertainties and limitations of test information precluded formulation of specific design equations. (auth)

5299 (AWRE-0/9/61) THE DRYING OF GASES BY SOLID ADSORBENTS. K. H. Garrett (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment; Aldermaston, Berks, England). Nov. 1961. 32p.

Information is presented on the adsorptive properties of alumina and molecular sieves for drying gases. A recommended design procedure for drying columns is included along with a specimen calculation. (J.R.D.)

5300 (GAMD-2731) A STUDY OF THE STABILITY OF RHODIUM AND BORON CARBIDE IN THE HTGR. H. K. Lonsdale (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nov. 16, 1961. Contract AT (04-3)-314. 24p.

The loss of rhodium and of boron from graphite compacts simulating HTGR fuel compacts and control rods respectively was studied experimentally. The mechanism of transport appeared to be vapor phase diffusion of Rh atoms and B atoms through the pores of the graphite. The loss rates were considerably less than one would predict from the Langmuir evaporation equation. Diffusion through the matrix rather than the evaporation from the surface of the compacts was the rate-determining step. Rhodium (and probably B) diffused down the activity gradient caused by the temperature gradient within the samples. During normal reactor operation, the losses of Rh and B were both insignificant, being <0.05% in three years. During a loss of coolant accident, the upper limit of the loss of Rh after 200 hours is 16% at 1750°C, 28% at 1900°C, and it is 50% or more at 2000°C. The upper limit of the loss of boron from B_4C-dispersed graphite control rods is 5 to 10% in 200 hours at 2000°C. (auth)

5301 (HW-66537) A REVIEW OF THE Zr-2 HYDRIDING PROBLEM. G. E. Zima (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 15, 1960. Contract AT(45-1)-1350. 28p.

The status of the Zr hydriding knowledge is reviewed and the hydriding problem presented by the NPR characterized. The hydriding processes were studied for the two different environments for the process tubes in the reactor: the water-fuel slug system on the process tube interior and the graphite-stack gas system on the process tube exterior. Studies are being carried out to establish the time sensitivity of conditions which have qualified as protective on a short term basis. Under stress conditions imposed by a notch and the impulsive loading of the impact test, relatively low hydrogen concentration effected a serious reduction in the impact strength of zirconium. The influence of hydrogen on ductility appeared to be magnified both by increasing the strain rate and by the presence of stress raisers. It was found that within the range of NPR service temperatures hydrogen imparts a substantial improvement in tensile strength. Work to date suggests that the embrittling influences of irradiation and hydrogen may compound. (M.C.G.)

5302 (IS-219) SOME THERMODYNAMIC PROPERTIES OF AQUEOUS SOLUTIONS OF TERBIUM. Robert Arthur Nelson and F. H. Spedding (Ames Lab., Ames, Iowa). May 1960. Contract W-7405-eng-82. 79p.

The conductances, transference numbers, and activity coefficients of aqueous solutions of terbium chloride and terbium bromide were measured at the equivalence pH. The properties were measured for concentrations up to 0.1 normal. The accuracy for all determinations was within 0.1%. The conductances were measured, using a Jones bridge and its accessories, and the transference numbers were determined by the moving boundary method. The activity coefficients were determined by a measurement of the emf of cells with transference. The experimentaly obtained activity coefficients were found to agree with the predictions of the Debye-Huckel Theory with a precision of about ±0.2%. Values for the distance of closest approach, å, indicate that the rare earth ion has one layer of water molecules surrounding the central ion. The properties obtained are compared with those of other rare earth bromides and chlorides. The data are tabulated. (P.C.H.)

5303 (LAR-55) INVESTIGATION OF HYDRIDING CHARACTERISTICS OF INTERMETALLIC COMPOUNDS. Summary Report, October 1, 1960 to October 31, 1961. Richard L. Beck (Denver. Univ. Denver Research Inst.). Nov. 15, 1961. Contract AT(33-3)-3. 82p.

The hydriding characteristics of about 250 intermetallic phases were investigated. About half of these were shown to react exothermically and reversibly with hydrogen by a gas-metal reaction at elevated temperatures. At least 18 of these phases formed ternary hydride phases having relatively high hydrogen content. Of considerable importance was the observation that 6 of these ternary hydrides contained more hydrogen than the individual components could absorb by themselves. The present program was intended primarily to provide an experimental search for new hydrogenous materials which exhibit high thermal stability at high N_H levels. None of the phases investigated so far have exhibited hydriding characteristics as good as those for zirconium or yttrium. However, a preliminary evaluation of these data was made which provides a valuable insight into the mechanism of occlusion and the factors which determine thermal stability and ultimate hydrogen content. (auth)

5304 (NEPA-934) THE HEAT CAPACITY OF U_3O_8 POWDER AS A FUNCTION OF TEMPERATURE (400-1800°F). Helen Powers, Frank Welch, and J. B. Trice (Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn.). Apr. 26, 1949. Decl. July 18, 1961. Contract [W-33-08-ac-14801(16250)]. 15p.

The mean heat capacity of a sample of powdered U_3O_8 was determined as a function of temperature from measurements of heat content. A thin-walled nickel capsule containing the material was heated in an electric furnace and dropped into a water calorimeter. The mean heat capacity values calculated from the experimental data were nearly constant over the temperature range, room temperature to 250-975°C (482-1790°F). The average value was 0.074 ± 0.004 cal $gm^{-1} {}^\circ C^{-1}$ (0.074 ± 0.004 Btu $lb^{-1} {}^\circ F^{-1}$). From 975-1100°C (1790-2012°F) a small rise was observed. (auth)

5305 (NEPA-935) THE HEAT CAPACITY OF URANIUM DIOXIDE AS A FUNCTION OF TEMPERATURE (400-1800°F). Anita Cabbage, Frank H. Welch, and J. B. Trice (Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn.). July 21, 1949. Decl. July 18, 1961. Contract [W-33-08-ac-14801(16250)]. 11p.

The mean heat capacity of a sample of powdered UO_2 was determined as a function of temperature from measurements of heat content. A thin-walled nickel capsule containing the material was heated in an electric furnace and dropped into a water calorimeter. The values calculated from the experimental data are nearly constant over the temperature range, room temperature to 250-1100°C (482-2012°F). The mean heat capacity is given by the equation $C_p = 0.070 \pm 0.005$ cal $gm^{-1} {}^\circ C^{-1}$ (0.070 ± 0.005 Btu $lb^{-1} {}^\circ F^{-1}$). (auth)

5306 (NP-11170) CANADIAN URANIUM RESEARCH FELLOWSHIP REPORT NO. 2, MAY 15 TO JUNE 15, 1961. J. Ciric (Canada. Ontario Research Foundation, Toronto). June 15, 1961. 14p. (CURF-R-12)

Glass formation in the ternary system $Li_2O-UO_2-B_2O_3$ was investigated. It is found that the region of glass formation is restricted to compositions containing 20% Li_2O and not more than 50 to 60% UO_2, the remainder being B_2O_3. The only exception to this is a composition containing 30% Li_2O, 30% UO_2, and 40% B_2O_3. Attempts to prepare glasses in the binary system $UO_2-B_2O_3$ were not successful because of the sluggish nature of the reaction between UO_2 and B_2O_3 at temperatures as high as 1300°C. Refractive indices of the homogeneous glasses were determined. The values vary between 1.541 and 1.682. (auth)

5307 (NP-11180) STUDIES OF RARE-EARTH HYDROGEN SYSTEMS. Final Report, Parts 1 and 2. James C. Warf and Kenneth Hardcastle (University of Southern California, Los Angeles). Aug. 1961. Contract Nonr 228(15). 105p.

A stainless steel high-pressure line with a gage that permitted the measurement of pressures up to 65 atmospheres was built and the hydrides of lanthanum, cerium, and ytterbium investigated. The lanthanum- and cerium-hydrogen systems were studied and equilibrium dissociation pressure-temperature-composition data obtained. The results were compared with the low-pressure data of other authors and with the high-pressure results on the cerium-hydrogen system by Streck and Dialer. Lines of constant composition were drawn through plots of the log P versus reciprocal absolute temperature data. From the slopes of these lines values for the heats of dissociation were obtained for the following reaction. $RH_{3-x} \rightarrow RH_{2-y} + (1 + y - x)/(2)\ H_2$, where R represents the rare-earth metal and x and y depend essentially upon the temperature and pressure. Heats of dissociation of $LaH_{2.70}$ and $LaH_{2.80}$ are 6.6 and 6.8 kcal/mole H_2 respectively, while those for $CeH_{2.80}$ and $CeH_{2.90}$ are 6.5 and 6.8 kcal/mole H_2 respectively. The lattice constant for a specimen of $CeH_{2.97}$ was determined to be 5.539 ± 0.001 A. A higher hydride of ytterbium was prepared. Absorption of hydrogen at approximately 20 atmospheres and several hundred degrees by ytterbium samples resulted in the formation of hydrides having the compositions $YbH_{2.55}$, $YbH_{2.2}$, and $YbH_{2.56}$. X-ray diffraction photographs of these hydrides showed the presence of a new face-centered cubic phase. The value of the lattice constant of this phase was determined to be 5.1921 ± 0.0012 A. Thermally decomposed and quenched samples of $YbH_{2.55}$ having the compositions of $YbH_{2.42}$ and $Yb_{2.04}$ were examined by X-ray diffraction techniques and found to contain an additional f.c.c. phase. The unit-cell constant of this phase was determined to be 5.2532 ± 0.0009 A. Annealing the sample of $YbH_{2.04}$ effected conversion of this metastable substance to orthorhombic ytterbium dihydride and to the f.c.c. (a = 5.192 A) higher ytterbium hydride. Measurements of the magnetic susceptibility of samples with $1.88 < H/Yb < 2.55$ were carried out, using the Gouy Method. The data could be interpreted in terms of mixtures of various amounts of virtually diamagnetic ytterbium dihydride and a strongly paramagnetic higher hydride of ytterbium containing Yb^{3+} ions. Infrared absorption spectra for several ytterbium hydrides were obtained and compared with the spectrum for a sample of CaH_2. Isotherms of dissociation pressure versus composition for the region $1.9 < H/Yb < 2.6$ consisted of two parts. Below approximately 13 atmospheres and 320°C plateaus were observed which indicated a two-solid-phase equilibrium, ytterbium dihydride and the higher ytterbium hydride, while above these critical conditions only one solid phase existed. The investigations indicate that a solid with the composition $YbH_{2.5}$ is a stable phase in the $YbH2-YbH_3$ system, and that the composition is dependent upon the pressure and temperature. From a van't Hoff plot of the plateau pressures versus reciprocal absolute temperature, the value for the heat of dissociation of $YbH_{2.5}$ was calculated to be 3.3 kcal/mole H_2. Attempts to prepare higher hydrides of europium and scandium by the reaction of the metals with hydrogen at several atmospheres and high temperatures were unsuccessful. Resistivity measurements on compressed, powder specimens of $LaH_{2.9}$, $CeH_{2.7}$, $PrH_{2.7}$, and $YbH_{1.9}$ showed respectively 10,000 ± 2000; 27,000 ± 4000; 20,000 ± 2000; and 30,000 ± 4000 ohms/cm. The temperature coefficient of resistivity, α, was determined for $LaH_{2.88}$ to be −0.006/°C. Examination of a specimen of $LaH_{2.8}$ using nuclear magnetic resonance techniques showed that the proton resonance absorption line width was extremely narrow for solids, approximately 40 milligauss, which indicated rapid movement of the protons in the metal lattice. The line width increased as the sample was cooled, and at −190°C was broadened sufficiently so as to be unobservable. This is interpreted as being due to the immobility or "freezing out" of the protons at these temperatures. X-ray powder diffraction photographs of $LuH_{2.9}$ were interpreted on the basis of a hexagonal closest-packed lattice of lutetium atoms with unit-cell constants of a = 3.573 A and c = 6.434 A. (auth)

5308 (PAN-138) PROTON SPIN LATTICE RELAXATION IN ACETIC ACID. A. Z. Hrynkiewicz, K. Krynicki, and T. Waluga (Polish Academy of Sciences. Inst. of Nuclear Research, Krakow). July 1961. 7p.

Experimental evidence of the non-exponential growth of proton magnetization in liquid acetic acid at several temperatures is presented. This is explained in terms of two different proton spin-lattice relaxation times in the CH_3 and COOH groups. (auth)

5309 (PAN-139) SPIN-SPIN NUCLEAR MAGNETIC RELAXATION IN LIQUID HYDROGEN CHLORIDE, ACETIC ACID AND METHYL FORMATE. O. K. Daszkiewicz (Polish Academy of Sciences. Inst. of Nuclear Research, Krakow). July 1961. 6p.

It was found experimentally in HCl that T_2 (spin-spin relaxation time) equaled 0.5 ± 0.01 sec and T_1 (spin-lattice relaxation time) equaled 18 ± 0.5 sec at 22°C. Assuming that the difference between T_1 and T_2 is caused by the indirect spin-spin interaction, the following parameters were calculated: $J/2\pi = 286$ c/sec, $\tau ex = 0.12\ \mu sec$, and $T_{1\,dip} = 21.6$ sec where J is the interaction constant, τex is the correlation time for this interaction, and $T_{1\,dip}$ is the dipolar part of the spin-lattice relaxation time. In acetic acid two simultaneous spin-spic relaxation times of 3.48 ± 0.2 and 12.6 ± 1 sec were found, but in the isomeric compound methyl formate only the single relaxation time 19.3 ± 0.9 sec was observed. A method of analyzing the spin echo decay curve is discussed. (auth)

5310 (TID-13828) TRITIUM EXCHANGE BETWEEN WATER AND SOME ALIPHATIC ALCOHOLS. M. J. Pro, W. L. Martin, and A. D. Etienne (Internal Revenue Service. Alcohol and Tobacco Tax Div. Lab., Washington, D. C.). July 1, 1961. Contract AT(49-11)-1845. 15p.

Experiments are described in which low tritium activity was added to alcohol−water solutions at room temperature and atmospheric pressure. The hydroxyl hydrogen of the anhydrous alcohol was cleaved with metallic Na in vacuum. The activity of the hydroxyl hydrogen was counted as was the water from the oxidized alcohol. Results indicate that the exchange reaction is between the water and the hydroxyl hydrogen of the alcohol and does not involve the hydrogen atoms attached to the carbon atoms. (J.R.D.)

5311 (TID-14361) REACTIONS IN NON-AQUEOUS SOLVENTS. Progress Report, October 1, 1960 to October 31, 1961. Helmut M. Haendler (New Hampshire. Univ., Durham). Nov. 1, 1961. Contract AT(30-1)-1964. 17p.

The work on the fluorometallate complexes of uranium and group V metals was completed. The preparative work on the ortho-quinone metal halide complexes was completed; preliminary thermogravimetric analysis, infrared spectra, magnetic moment data, visible and ultraviolet spectrophotometry, and x-ray data indicate the need for more detailed structural information. Attempts to prepare ternary fluorides of silver(I) and thallium(I) from nonaqueous solutions led to a study of a new reaction for the potential preparation of anhydrous inorganic nitrates and subsequent conversion to fluorides. Displacement reactions of silver nitrate with metals, in methanol as solvent, occur quite readily, and the construction of an electrochemical series based on this reaction seems feasible. Ammonium hexafluorostannate(IV), $(NH_4)_2SnF_6$, was prepared in the anhydrous form from methanol solution. Its x-ray powder pattern has been indexed on the basis of its similarity to the known structure of K_2GeF_6. Thermogravimetric analysis indicates the formation of NH_4SnF_5, hitherto unreported. Thermogravimetric and differential thermal analysis of ammonium heptafluorozirconate(IV) $(NH_4)_3ZrF_7$, substantiate previous reports of a three step decomposition. Some preliminary kinetic studies of the decomposition of NH_4ZrF_5 were made. Additional studies on the thermal decomposition of ammonium hexafluoroferrate(III) did not clarify the nature of this reaction. At least two stages seem to be indicated. Fluorination of potassium ferrate(VI), K_2FeO_4, with chlorine trifluoride gave products in which K_3FeF_6 and Fe_2O_3 were detectable by x-ray diffraction techniques. No direct evidence for a higher fluoride of iron was found. An IBM 1620 computer technique for the calculation of unit cell parameters from x-ray powder data was developed and is being tested. It is based upon the Ito method in which arbitrary assignment of a triclinic primitive cell is made. The unit cell of tin(II) fluoride is shown to be monoclinic $a = 4.23$ Å, $b = 4.90$ Å, $c = 5.14$ Å, $\beta = 85.96°$, with 2 formula units per unit cell. Its structure appears to be similar to that of copper(II) fluoride, determined previously. (auth)

5312 (TID-14370) SURFACE CHEMISTRY PHENOMENA. PROGRESS REPORT. PART I. HYDROGEN IN NICKEL. Vernon LeFebre, Carl J. Christensen, and Henry Eyring. PART II. ELECTRODE DEPOLARIZATION KINETICS ON OPEN CIRCUIT. T. N. Andersen, H. Eyring, and C. J. Christensen. PART III. CATALYTIC POISONING OF A SMOOTH PLATINUM CATHODE. Joel Jacknow, Carl J. Christensen, and Henry Eyring. PART IV. TRANSIENT ELECTRODE POTENTIALS AND INTERFACIAL CAPACITIES OF NICKEL AND LEAD. A. M. Spencer, C. R. Brinkman, and M. E. Wadsworth. PART V. CORROSION OF METALS IN FUSED SALT SYSTEMS. Larry L. Anderson and George Richard Hill (Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes). Oct. 31, 1961. Contract AT(11-1)-82. 52p.

Progress is reported on research on surface chemistry phenomena. Topics covered include hydrogen in nickel, electrode depolarization kinetics on open circuit, catalytic poisoning of smooth platinum cathode, transient electrode potentials and interfacial capacities of nickel and lead, and corrosion of metals in fused salt systems. (M.C.G.)

5313 (TID-14384) INFRARED EVIDENCE FOR BISULFATE FORMATION IN THE DEHYDRATION OF MAGNESIUM SULFATE. Technical Report No. 1. J. S. Cho, F. A. Olson, and M. E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Oct. 5, 1961. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26, Subcontract 3003. 25p.

In the dehydration of magnesium sulfate there is evidence of a bisulfate, $Mg(HSO_4)_2$, stage in the approximate temperature range of 150 to 250°C. Infrared and thermogravimetric studies indicated the following mechanism to be reasonable: $2\ MgSO_4 \cdot 1\ H_2O \rightarrow Mg(HSO_4)_2 \cdot Mg(OH)_2 \rightarrow 2\ MgSO_4 + 2\ H_2O$. The x-ray diffraction pattern of the bisulfate stage was different from the monohydrate but essentially the same as that of the anhydrous stage. Three characteristic infrared absorption bands in the range of 8 to 10 μ wavelength and one band at 14.4 μ were observed for anhydrous $MgSO_4$. Also, characteristic infrared patterns of the hydrates $MgSO_4 \cdot 7\ H_2O$, $MgSO_4 \cdot 6\ H_2O$, and $MgSO_4 \cdot 1\ H_2O$ were determined using high temperature x-ray diffraction patterns to identify the structure of the compounds. (auth)

5314 (TID-14468) A PLATINUM CATALYST FOR THE COMBINATION OF HYDROGEN AND OXYGEN IN THORIA SLURRIES. Technical Report No. XII. Ralph M. Horton, C. Keith Hanson, and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Aug. 15, 1961. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26, Subcontract 1075. 37p.

A platinum catalyst was prepared by refluxing an aqueous suspension of platinic acid and thorium hydroxide together. A small amount of this catalyst was added to a thoria slurry in an autoclave. After the slurry was heated and while it was being agitated, oxygen and hydrogen were added to the autoclave and their rate of combination followed by recording the pressure as a function of time. The reactions were usually first order with respect to pressure. Results indicated that the catalyst was adsorbed on the previously inert thoria, causing an increase in the rate. The activation energy for the process was 4.0 kcal/mole. The kinetics were found to be first order with respect to oxygen. These facts suggested that the slow step in the reaction was the diffusion of oxygen to the catalyst. The catalyst was found to maintain its activity even after 100 tests upon the same charge. (auth)

5315 (WADD-TR-61-123) PROPERTIES OF YTTRIUM AND THE RARE EARTH METALS OXYGEN AND ALLOY SYSTEMS. OXYGEN AND ALLOY SYSTEMS. Bernard Love (Research Chemicals. Div. of Nuclear Corp. of America, Burbank, Calif.). Feb. 20, 1961. Contract AF33(616)-6829. 179p.

Partial constitutional diagrams were established for a number of systems containing yttrium and the lanthanide elements. Alpha yttrium and erbium are completely soluble in all proportions. The yttrium–neodymium system is more complex. There is partial solubility at both ends of the system. An intermediate phase is present at the equiatomic percentage composition. No marked beta phase stabilization was established. The rare earth rich end of the yttrium, erbium, neodymium, and samarium systems with oxygen were investigated. The solubility of oxygen is low in the metals at temperatures up to the transformation temperature or 1000°C. The transformation temperature of neodymium is essentially unaffected, that of samarium is raised slightly. The nature of the elevated temperature portion of each system is less certain and two alternative phase diagrams are proposed. The preferred diagram indicates the presence of a high temperature interstitial monoxide. The cobalt end of the cobalt–erbium system was investigated. A number of intermetallic compounds are formed. The first of these, $Co_{17}Er_2$, enters into eutectic reaction with cobalt. The solubility of erbium in cobalt is low, and the cobalt phase transformation is essentially unaffected by the presence of small additions of erbium. The cobalt–yttrium system appears to be similar.

Tantalum–lanthanum, tantalum–erbium, tantalum–ytterium, niobium–erbium, and niobium–yttrium systems were investigated. All systems were similar in their general characteristics. An extensive liquid immiscibility region is present which terminates in a monotectic very near the tantalum (niobium) end of the system. A eutectic is present at the rare earth end of the system. Room temperature solid solubility is very low, but there may be slight solubility at elevated temperature. The alpha to beta transformation temperature was determined to be 848°C for neodymium and 930°C for samarium. The transformation temperature of yttrium is approximately 20 to 30°C below the melting point of yttrium. Both the transformation and melting temperatures are somewhat dependent upon metal purity. Atmospheric corrosion rates were determined in the above systems. Lower rates were found for certain niobium alloys, and for cobalt compositions, with added rare earths. Improved mechanical properties were found for yttrium–erbium alloys and for yttrium–zirconium alloys ascribed to solid solution hardening. The latter age at room temperature and rapidly overage at elevated temperatures. Procedures for purification of yttrium and erbium by vacuum distillation were developed. Improved methods for oxygen and tantalum analysis are described. The addition of erbium to beryllium yields alloys with improved purity and grain refinement. (auth)

5316 (WIS-AEC-6) SHORT RANGE INTERMOLECULAR FORCES. II. H_2-H_2 AND H_2-H. Edward Mason (Maryland. Univ., College Park. Inst. of Molecular Physics) and Joseph O. Hirschfelder (Wisconsin. Univ., Madison. Naval Research Lab.). June 6, 1956. Contracts AT(11-1)-298 and NOre-595(02). 34p.

The energy of interaction between two hydrogen molecules and between a hydrogen atom and a hydrogen molecule were calculated using a method developed for approximating the 3- and 4-center integrals. The results are in good agreement with previous calculations of Margenau and with existing experimental data. The multiple exchange and zeroeth order perturbation made the calculations somewhat complicated. Following de Boer's procedure for the case of a hydrogen atom hydrogen molecule interaction, very poor results were obtained. (auth)

5317 (AEC-tr-4454) JOURNAL OF INORGANIC CHEMISTRY. Translated from Zhur. Neorg. Khim., 3, No. 6, 1273-1470(1958). 287p. (PST-Cat.-376)

Included are 30 articles on studies of: the zirconium hydroxide formation reaction; energy characteristics of gallium and indium arsenide and antimonide semiconductors with zinc-blend structures; zinc-lithium silicate phosphors activated by manganese; thermal decomposition of strontium, barium, and lead selenates; carbonate and oxalatocarbonate complexes of plutonium(IV); preparation of Cossa's salt; synthesis mechanism of platinum(IV) hexammine; platinum ethanolamine compounds; amino derivatives of trimethylplatinum; trimethylthiocarbamide compounds of platinum(IV); heating curves of cobaltiammines; complex formation of cerium(IV) with acetate and oxalate; synthesis of cerimolybdic heteropolyacid; slightly soluble salts of the heteropolyacids of germanium and silicon; viscosity and density of $PbO-V_2O_5$ systems; sulfur–selenium systems with low-selenium concentrations; equilibrium of the Al–Fe–Ti ternary alloy; refractometry of reactions in solutions; uranyl nitrate–dibutyl ether–water system solubility isotherm at 25°; solubility polytherms of potassium and cesium tetrafluoroborates; crystallization of silicate melts; perchloric acid and its derivatives; phase diagrams of LiOH–LiCl and LiOH–NaOH systems; determination of gaseous impurities in titanium; ion distribution between solid and liquid phases; extraction of iron with organic solvents using a radioisotope; complex formation in $NiSO_4-H_2SO_4-H_2O$ systems; acetates of zinc and beryllium; lanthanum acetate pentahydrate; and Hall effect diagrams of Mo–W alloys. Author and subject indexes are included. (B.O.G.)

5318 (CEA-tr-R-1401) ETUDE DE LA STABILITÉ DES FLUORURES COMPLEXES DE CERTAINS MÉTAUX. (Study of the Stability of Fluoride Complexes of Certain Metals). A. K. Babko and L. G. Shimadina. Translated into French from Zhur. Neorg. Khim., 4: 1060-6(1959). 18p.

In order to establish the stability series of fluoride complexes the metal–indicator systems Fe^3-SCN^- and $Ti^4-H_2O_2$ were used. The following stability series for simple fluoride complexes of the MF^n type was established: Zr^4 (Hf) > Th^4 > La^3 > Nb^5 > Ta^5 > Al^3 > Sn^4 > Be^2 > Fe^3 > BO_2^- > Ga^3 > Tl^3 > (In^3, Ge^4, and SiO_2). The approximate values of the instability constants were calculated, and these values agree satisfactorily with the bibliographic data. (tr-auth)

5319 CRYSTALLOGRAPHIC DATA OF Sr_2CrO_4. Karl-Axel Wilhelmi and Ola Jonsson (Univ. of Stockholm). Acta Chem. Scand., 15: 1415-16(1961). (In English)

Crystals of Sr_2CrO_4, suitable for single crystal x-ray studies, were prepared from chromium(III) oxide, strontium chromate(VI), and carbonate-free strontium hydroxide in a platinum crucible at 900°C with argon as a protecting gas. Approximate values of cell dimensions were obtained from Weissenberg photographs and more accurate values were then obtained from a Guinier powder photograph with strictly monochromatized CuK_1 radiation. The crystal was shown to be orthorhombic. All attempts to solve the structure on the basis of the space group No. 62 Pnma failed, and it was concluded that the space group might be No. 33 $Pn2_1a$. The distribution of the metal atoms indicates that Sr_2CrO_4 is isomorphous neither with K_2NiF_4 nor with K_2CrO_4, but that the structure very likely contains discrete four-coordinated chromium–oxygen complexes similar to those found in K_2CrO_4. (P.C.H.)

5320 UNIT CELL DIMENSIONS OF YTTRIUM IRON GARNETS CONTAINING NEODYMIUM, PRAESODYMIUM AND LANTHANUM IONS. M. Schieber (Weizmann Inst. of Science, Rehovoth, Israel) and Z. H. Kalman. Acta Cryst., 14: 1221-2(Dec. 1961).

Replacement of Nd, Pr, and La for Y in iron garnets was studied. The unit cell dimensions varied from 12·380 Å for Y_3FeO_{12} to 12·530 Å in $[YNd_2]Fe_2Fe_3O_{12}$, 12·478 Å in $[Y_2Pr]Fe_2Fe_3O_{12}$, and 12·434 Å in $[Y_{2.5}La_{0.5}]Fe_2Fe_3O_{12}$ for the maximum amount of the lighter rare earth ions substituted for yttrium in iron garnets. (auth)

5321 A NOTE ON THE CRYSTAL STRUCTURE OF ZIRCONIUM PYROPHOSPHATE. H. McD. McGeachin (Albright and Wilson (Mfg) Ltd., Birmingham, Eng.). Acta Cryst., 14: 1286(Dec. 1961).

The linearity of the central P-O-P group in ZrP_2O_7 is discussed. It is suggested that the only way to distribute the seven oxygen atoms is to place one on the axis and six in two symmetrical groups of three. To preserve four-fold grouping of oxygen atoms around the phosphorus atoms, the only possible configuration is one in which the single oxygen atom is placed on the three-fold axis between the phosphorus atoms. (P.C.H.)

5322 LATTICE-PARAMETER CHANGES IN THE PSEUDO-BINARY SYSTEM OF TITANIUM AND ZIRCONIUM DIHYDRIDES. A. D. McQuillan and N. Pessall (Univ. of Birmingham. Eng.). Acta Cryst., 14: 1287-8(Dec. 1961).

Alloys of titanium and zirconium were prepared and examined by x-ray-diffraction analysis. At the temperature of the measurements (26 ± 3°C) both titanium dihydride ($TiH_{1.99}$) and zirconium dihydride ($ZrH_{1.98}$) were found to have a tetragonal structure. The parameters for zirconium dihydride were found to be a = 4.992 ± 0.005 and c = 4.455 ± 0.005 Å, and for titanium dihydride a = 4.465 ± 0.005 and c = 4.453 ± 0.005 Å. An extensive range of solid solution of titanium dihydride exists, but the titanium dihydride shows only limited solubility for zirconium dihydride. In zirconium-rich dihydrides, the parameters are linear functions of composition, and the a/c ratio decreases progressively with increasing titanium content. Extrapolation of the a parameter to zero zirconium content gives a value in close agreement with the value of a for titanium dihydride. For the c parameter agreement is less perfect but the difference is not great. It is suggested that these results support the hypothesis that the cause of tetragonality in the dihydrides of titanium and zirconium is the same. (P.C.H.)

5323 . METAL OXIDE ALKOXIDE POLYMERS. PART III. THE HYDROLYSIS OF SECONDARY AND TERTIARY ALKOXIDES OF ZIRCONIUM. D. C. Bradley and D. G. Carter (Birkbeck Coll., London). Can. J. Chem., 40: 15-21(Jan. 1962).

The hydrolysis of zirconium alkoxides with secondary or tertiary alkoxide groups $Zr(OR)_4$, where R = Pr^i, Bu^s, Bu^t, and Am^t, was studied. The hydrolysis leads to the formation of polymeric zirconium oxide alkoxides having low number-average degrees of polymerization. The variation of number-average degree of polymerization as a function of the degree of hydrolysis for zirconium isopropoxide and zirconium sec-butoxide conformed to the requirements of a structural model for the polymers based on octahedrally 6 co-ordinated zirconium. At high degrees of hydrolysis it appears that highly solvated species are present and that hydrolysis may be incomplete in solution. (P.C.H.)

5324 THE SOLUBILITY OF BERYLLIUM OXIDE IN AQUEOUS BERYLLIUM SULPHATE SOLUTIONS. S. L. Bennett and W. J. Biermann (Univ. of Manitoba, Winnipeg). Can. J. Chem., 40: 73-7(Jan. 1962).

It was observed that ignited beryllium oxide was soluble in concentrated aqueous solutions of beryllium sulfate to the extent of 1 mole of oxide per 2 moles sulfate, saturation being virtually complete within 6 hours at 180°C. Since the molar solubility of aluminum oxide is much lower under similar conditions, it is suggested that partial resolution of oxide mixtures might be made on this basis. (auth)

5325 SOME OBSERVATIONS IN THE REACTION OF URANOUS-URANIC OXIDE (U_3O_8) WITH ACIDS. N. I. Blinova, V. M. Solntsev, and Yu. M. Tolmachev (Khlopin Radium Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 140: 1314-16(Oct. 21, 1961). (In Russian)

It is well known that UO_2^{2+} and U^{4+} ions are formed in a 2:1 ratio on complete dissolution of a U_3O_8 sample in an acid solution in the absence of an oxidizing agent. Hexavalent uranium goes into solution primarily during the initial stages of dissolution. Thus, the ratio of U(VI) to U(IV) is 76:1 in 2.0 M H_2SO_4, 60:1 in 11.7 M $HClO_4$ and >300:1 in 1.7 M CH_3COOH for 3 to 20% dissolution of the U_3O_8 sample in a CO_2 atmosphere at constant temperature (25°C and 90°C). On dissolution of a 390 mg sample of U_3O_8 in $HClO_4$ at 90°C it was found that the ratio of U(VI) to U(IV) in solution decreased from 59:1 for a 10 minute reaction time to 1:1 for a reaction time of 120 minutes. The ratio of U(VI) to U(IV) in the sample residue after dissolution varied from 1.85:1 to 1:1 for various experiments. After attainment of a ratio of 1:1 in solution, the ratio of U(VI) to U(IV) in the residue was always found to be 1:1 (this ratio is 2:1 during dissolution in HNO_3). On the basis of these data the preferred formula for U_3O_8 is $UO_3 \cdot U_2O_5$. It is assumed that U(V) disproportionates to U(VI) and U(IV) in a 1:1 ratio during dissolution of U_3O_8 in acid. (TTT)

5326 THE USE OF BIS-(2-ALKOXYETHYL)ETHERS AS ANTIFREEZE IN NAPHTHALENE–1,4-DIOXANE SCINTILLATION MIXTURES. F. A. Loewus (Western Regional Research Lab., Albany, Calif.). Intern. J. Appl. Radiation and Isotopes, 12: 6-9(Nov. 1961). (In English)

Aqueous radioactive samples can be counted in naphthalene–1,4-dioxane scintillator mixtures at temperatures below 0°C without freezing by replacing a portion of the 1,4-dioxane with bis-(2-methoxyethyl)ether (diglyme) or bis-(2-ethoxyethyl)ether (diethyl carbitol). As little as 2 ml of diglyme or diethyl carbitol will allow 15 ml samples containing 1 ml of water to be counted at −4°C with better than 90 per cent of the efficiency of the pure naphthalene–1,4-dioxane system. (auth)

5327 ON DISPROPORTIONATION REACTIONS OF ORGANIC COMPOUNDS CONTAINING Zr, Ti, AND Fe. E. M. Brainina and R. Kh. Freidlina (Inst. of Elemento-organic Compounds, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 9, 1595-9 (Sept. 1961). (In Russian)

Effects of water on zirconium triacetylacetonate chloride, zirconium tribenzoylacetonate nitrate, zirconium isopropoxytriacetylacetonate, and iron diacetyl- and dibenzoylacetonate were analyzed. It was found that in all cases a disproportionation takes place leading to the formation of zirconium tetraacetyl (tetrabenzoyl) acetonates or iron triacetyl (tribenzoyl) acetonates. A crystalline tetraacetoxytetraethoxytrititanoxan, $(CH_3CO_2)_4\,(C_2H_5)_4\,Ti_3O_2$, was prepared from the ethylorthotitanate reaction with acetic anhydride in 1:2 molar ratios. (R.V.J.)

5328 ROTATIONAL AND VIBRATIONAL CONSTANTS OF THE HCl^{35} AND DCl^{35} MOLECULES. D. H. Rank, D. P. Eastman, B. S. Rao, and T. A. Wiggins (Pennsylvania State Univ., University Park). J. Opt. Soc. Am., 52: 1-7(Jan. 1962).

The 1–0, 2–0, 3–0, 4–0, and 5–0 bands of HCl^{35} and the 1–0 and 2–0 bands of DCl^{35} were measured with high precision. A critical analysis was made to determine the rotational and vibrational constants of these molecules. It is necessary to use a polynomial in m of the sixth degree to satisfactorily represent the frequencies of the band lines in the case of the most precisely measured bands. B_0 for HCl^{35} was found to have a value of 10.440254 ± 0.000010 cm^{-1}. B_0 for DCl^{35} was found to be 5.392261 ± 0.000010 cm^{-1}. The observed rotational and vibrational constants (Y_{ij}) were used to calculate the potential constants of HCl^{35} by making use of a rotating vibrator. It is shown that HCl^{35} is not a pure rotating vibrator since the observed and calculated values of $Y_{02} \sim D_e$ are in disagreement by about 1 part in 1000 which is approximately 10 times the experimental error. By making use of the molecular constants for HCl^{35} and DCl^{35} and the accurately known atomic masses it is deduced that the ground level B_e is perturbed by the upper electronic levels by 1 part in 8000. The sign of the perturbation is to increase B_e over its unperturbed value. The sign of the perturbation is such that it may be presumed the HCl molecule has a positive magnetic moment. It was calculated that μ_J = +0.2 and +0.1 nuclear magnetons, respectively, for HCl^{35} and DCl^{35}. (auth)

5329 EMULSION METHOD OF EXTRACTING COLLOIDAL MIXED URANYL FERROCYANIDE FROM ITS

HYDROSOLS. V. I. Borisikhina, L. D. Skrylev, and S. G. Mokrushin (Urals Polytechnic Inst., Sverdlovsk, USSR). Kolloid. Zhur., 23: 521-3(Sept.-Oct. 1961). (In Russian)

Colloidal mixed uranyl ferrocyanide may be isolated from sols containing small amounts of gelatin at a hydrosol–carbon tetrachloride interfacial boundary. Additions of electrolytes [$Al(NO_3)_3$, $Ba(NO_3)_2$, and KNO_3] to the sols are found to promote the isolation of the colloid, the effect being the greater, the larger the amount of added electrolyte and the higher the valency of its cations. Highly concentrated gelatinized carbon tetrachloride emulsions stabilized by colloidal mixed uranyl ferrocyanide may be destroyed by monoatomic alcohols and acetone. (auth)

5330 PLUTONIUM FUSED SALTS FUELS FOR FAST BREEDER REACTOR. NUCLEAR AND CHEMICAL CRITERION. Mieczysław Taube (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 565-85(1961). (In English)

A critical review of fused salt fuels for fast breeder power reactors is presented. The suitable fuels contain fused mixed chlorides of plutonium, uranium, sodium, potassium, calcium, magnesium, copper, and zinc diluent, and chlorine-37. (auth)

5331 SOME EXPERIMENTS ON THE GROWTH AND PURITY OF ALKALI HALIDE CRYSTALS AND THEIR DARKENABILITY UNDER X-IRRADIATION. Sunil K. Datta (Indian Assn. for the Cultivation of Science, Calcutta). Proc. Natl. Inst. Sci. India. Pt. A, 27: 167-74(May 26, 1961). (In English)

Attempts were made to prepare single crystals of alkali halides in as pure a state as possible and the effect of x rays on them was studied. Crystals were grown from aqueous solutions and the vapor state, and discs prepared by pressing micro-crystals in a die. From the optical absorption vs. wavelength curves of the x irradiated samples of these and of two melt-grown and a barium-doped water-grown crystal, the F-center concentrations were calculated. It was observed that impurities caused some increase in the darkenability of the crystals but the effects were not very large. (auth)

5332 ON THE ELECTRONIC STRUCTURE OF HeH^+. Rama Bhattacharya (University Coll. of Science and Tech., Calcutta). Proc. Natl. Inst. Sci. India. Pt. A, 27: 185-92 (May 26, 1961). (In English)

Theoretical calculation of the electronic energy of HeH^+ by a quantum mechanical method at various internuclear distances shows that the equilibrium internuclear separation appears at 1.75 au as compared to the value of 1.50 au previously reported by others. The electronic charge was concentrated wholly on He nucleus in the bonding state giving to HeH^+ a structure $He-H^+$. From the convergence of bonding and antibonding energy curves it was concluded that HeH^+ dissociates as He^+ and H. (auth)

5333 STANDARD ENTHALPY OF LITHIUM FLUORIDE FORMATION. V. P. Kolesov and S. M. Skuratov (Moscow State Univ.). Zhur. Neorg. Khim., 6: 1741-4 (Aug. 1961). (In Russian)

The enthalpy of lithium hydroxide neutralization by hydrofluoric acid ($\Delta H = 16.5 \pm 0.03$ kcal/mole) and of lithium hydrofluoride dissolution in water ($\Delta H = 1.25 \pm 0.02$ kcal/mole) was determined. The standard enthalpy of LiF formation is evaluated to be equal -146.2 ± 0.3 kcal/mole. (R.V.J.)

5334 REACTIONS OF ZIRCONIUM OXYCHLORIDE WITH SULFURIC ACID AND AMMONIUM, ALUMINUM, IRON, AND SODIUM SULFATES. A. K. Kirakosyan and I. V. Tananaev (Kurnankov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 1808-12(Aug. 1961). (In Russian)

Studies were made of reactions in $ZrOCl_2 - Me_2SO_4 - H_2O$ systems; where Me = H^+, Na^+; NH_4^+, $\frac{1}{2}$ Fe^{2+}, and $\frac{1}{3}$ Al^{3+}; in the region of oxysulfate precipitation. It is shown that under certain conditions a complete precipitation of zirconium from oxychloride solutions can be achieved in the form of basic zirconium sulfates of various compositions. (R.V.J.)

5335 COMPLEX COMPOUNDS OF Np(V) WITH CITRIC AND TARTARIC ACIDS. A. I. Moskvin, I. N. Marov, and Yu. A. Zolotov (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 1813-20(Aug. 1961). (In Russian)

Complexing between pentavalent neptunium and citric acid was studied by cation exchange. Complexes of NpO_2Cit^{2-} and NpO_2HCit^- with stability constants equal to $(4.7 \pm 1.0) \times 10^3$ (pK = 3.67) and $(4.9 \pm 1.4) \times 10^2$ (pK = 2.69) are formed at pH 4.3 to 5.2. Is is also shown that at pH 3.2 to 6.2 Np(V) forms complex ions with tartaric acid (NpO_2HTar, NpO_2Tar^-, $NpO_2Tar_2^{3}$, and $NpO_2Tar_3^{5-}$) with stability constants equal to 2.3×10^3 (pK = 2.36), 2.1×10^2 (pK = 2.32), (2.0×10^4) (pK = 4.30), and 1.5×10^6 (pK = 6.18) respectively. (R.V.J.)

5336 KINETICS OF CATHODE AND ANODE POLARIZATION IN UO_2^{2+} SULFURIC ACID SOLUTIONS. Ya. P. Gokhshtein and Ts'ai-chêng Kao (Vernadskii Inst. of Geochemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 1821-30(Aug. 1961). (In Russian)

The kinetics of UO_2^{2+} reduction and oxidation of products of electrolysis on a mercury electrode was studied by oscillographic polarography. Is is shown that in H_2SO_4 solution from 0.005 to 1.0 N the uranyl ion is reduced in three stages. The first stages, $UO_2^{2+} + e \rightleftharpoons UO_2$, are quasi-reversible with a slight deflection from the reverse process. The second and third stages correspond to irreversible $UO_2^+ + e + 2H^2 \rightarrow UO^{2+} + H_2O$ and quasi-reversible $UO^{2+} + e \rightleftharpoons UO^+$. The cathode and anode waves of uranium in 0.005 to 0.1 N sulfuric acid solutions are analyzed, and the rate constants and free activation energies for the three stages of uranyl ion activation in 0.005 N H_2SO_4 are calculated. (R.V.J.)

5337 SOLUBILITY IN $In_2(SO_4)_3 - Cs_2SO_4 - H_2O$ SYSTEM AT 20°. E. N. Deichman (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 1831-6(Aug. 1961). (In Russian)

The solubility isotherm (20°) in $In_2(SO_4)_3 - Cs_2SO_4 - H_2O$ was studied; compounds of $CsIn(SO_4)_2 \cdot 12H_2O$ and $Cs_2In(OH)_2(SO_4)_2 \cdot nH_2O$ were formed. Thermographic and crystaloptic analyses were made of double salts, and the solubility and electric conductivity of $CsIn(SO_4)_2 \cdot 12H_2O$ were determined. (R.V.J.)

5338 SPECTROPHOTOMETRIC STUDIES OF CARBONATE COMPLEXES OF RARE EARTHS. N. S. Poluektov and L. I. Kononenko (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zhur. Neorg. Khim., 6: 1837-42(Aug. 1961). (In Russian)

Absorption spectra of Dy, Er, Eu, Gd, Ho, Nd, Pr, Sm, Tm, and Yb carbonate systems were studied, and a shift and partial split were observed in the maximum absorption band. In some cases an increase in absorption maximum was also observed. The larger absorption was noticed in Nd, Sm, Ho, and Er. Spectrophotometric studies using logarithmic curve gradients indicate that 4 carbon ions are found per metal atom in Nd. The complex formation constant is ~12. (R.V.J.)

5339 PYROCATECHOL TITANIUM COMPLEXES. S. Ya. Shnaiderman and I. E. Kalinchenko, Zhur. Neorg. Khim., 6: 1843-9(Aug. 1961). (In Russian)

Formation of complex systems in titanium pyrocatechol was studied in the presence of sodium acetate and without buffer solutions. It is shown that colored complexes of TiOR solutions are formed at pH 2 to 4. Complex anion $TiOR_2^{2-}$ is formed with reduced acidity at pyrocatechol concentration of 1×10^{-3} to 10^{-4} mole. The instability constants of colored complexes are $K = [(TiO^{2+})(R^{2-})/(TiOR)] = (3.3 \pm 0.5) \times 10^{-23}$ and $K_2 = [(TiOR)(R^2)/(TiOR_2^{2-})] = (1.1 \pm 0.6) \times 10^{-16}$, $\mu = 0.5$. (R.V.J.)

5340 REACTIONS OF POTASSIUM FLUOROZIRCONATE WITH SODIUM HYDROXIDE AND AMMONIUM IN AQUEOUS SOLUTIONS. I. A. Sheka and A. A. Lastochkina (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zhur. Neorg. Khim., 6: 1868-74(Aug. 1961). (In Russian)

The effects of ammonium, sodium hydroxide, and potassium fluorozirconate concentration on the composition of basic salts formed in systems of $K_2ZrF_6-NH_4OH-H_2O$ and $K_2ZrF_6-NaOH-H_2O$ were analyzed. In ammonium reactions with potassium zirconium fluoride the basic salt $Zr(OH)_2F_2 \cdot nKF \cdot mH_2O$ first separates by forming $ZrO(OH)F \cdot nKF \cdot mH_2O$, which in turn hydrolyzes forming zirconium hydroxide in saturated ammonium and water. Zirconium hydroxyfluorides are stable at pH 5 to 9, at higher pH they disintegrate forming zirconium hydroxide. (R.V.J.)

5341 REACTIONS OF SAMARIUM IONS WITH ETHYLENEDIAMINETETRA ACETIC ACID. I. V. Tananaev and G. V. Shevchenko. Zhur. Neorg. Khim., 6: 1909-13(Aug. 1961). (In Russian)

Specific electric conductivity and electromotive forces of isomolar series and series with constant concentrations of samarium were measured in $SmCl-Na_2H_2Y-H_2O$, $SmCl_3-Na_3HY-H_2O$, and $Sm(NO_3)_3-NaY-H_2O$ systems. It was found that in acid media the solution forms an H (SmY) which dissociates into H^+ and $[SmY]^-$. In alkali media a complex anion $[SmY]^-$ is formed. The constant for the acid dissociation is $K_H \sim 6 \times 10^{-3}$, while the stability of the complex anion $(SmY)^-$ is pK = 16.45 (25°). (R.V.J.)

5342 COMPLEXING OF SYSTEMS CONTAINING RARE EARTH NITRATES AND TRI- OR DIBUTYLPHOSPHATE. Z. A. Sheka and E. E. Kriss. Zhur. Neorg. Khim., 6: 1930-5(Aug. 1961). (In Russian)

Reactions of La, Nd, Y, and Yb nitrates with tributylphosphate and Nd and Yb with dibutylphosphate were studied by analyzing the distribution between aqueous and nonaqueous phases. At nitric acid concentration of 1 to 3 mole/l the number of TBP groups per lanthanide nitrate is 3; the number of DBP groups reacting with each rare earth nitrate is also equal to three or (in saturated reagent) to multiples of three. The stability of $Ln(NO_3)_3 \cdot 3TBP$ (K_1 = 1 for Ld, Nd, Y, and Yb) was evaluated and the equilibrium formation constant was determined. (R.V.J.)

5343 REACTIONS OF $InCl_3$ WITH Al. A. P. Palkin, T. A. Marshakova, and A. S. Vinokurova. Zhur. Neorg. Khim., 6: 1971-2(Aug. 1961). (In Russian)

Thermographic, spectral, and chemical analyses were made of In reactions with Al in melts. It was found that the reaction is carried out quite intensely with large exothermal effects. (R.V.J.)

5344 SOLUBILITY OF INTRACOMPLEX Cu, Ni, AND U COMPLEXES WITH 8-OXYQUINOLINE. E. P. Trailina, V. V. Zelentsov, I. A. Savich, and V. I. Spitsyn. Zhur. Neorg. Khim., 6: 2048-51(Sept. 1961). (In Russian)

Acid dissociation constants are determined for three Mannich bases, and solubility products of 8 intracomplex copper, nickel, and uranium(VI) compounds are determined. (tr-auth)

5345 URANYL OXALATOSULFATORHODANATE COMPOUNDS. V. P. Markov and T. V. Sergeeva (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 2052-8(Sept. 1961). (In Russian)

Seven mixed uranyl oxalatosulfatorhodanates were prepared with the following compositions: $(NH_4)_4[(UO_2)_2C_2O_4(SO_4)(CNS)_2] \cdot 6H_2O$, $K_4[(UO_2)_2C_2O_4(SO_4)_2(CNS)_2]$; $Cs_4[(UO_2)_2C_2O_4(SO_4)_2(CNS)_2]$, $Rb_4[(UO_2)_2C_2O_4(SO_4)_2(CNS)_2]$, $(NH_4)_4[UO_2)_2(C_2O_4)_2(CNS)_2(H_2O)_2]$, $K_3[UO_2C_2O_4SO_4CNS]$, and $K_8[(UO_2)_2(C_2O_4)_3(SO_4)_2(CNS)_2]$. The stability of compounds in solution increases with increased coordinated acid groups in the uranyl sphere. It is shown that only one rhodanate group attaches to one atom of uranyl. (R.V.J.)

5346 URANYL COMPOUNDS WITH 1, 10 PHENANTHROLINE AND 2, 2′ DIPYRIDYL. V. P. Markov and V. V. Tsapkin (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 2059-61(Sept. 1961). (In Russian)

Descriptions are given of the synthesis of the following four uranyl compounds with 1, 10-phenanthroline and 2, 2′-dipyridyl: $UO_2(OH)ClC_{12}H_8N_2 \cdot H_2O$, $(UO_2)_2(OH)_2SO_42C_{12}H_8N_2 \cdot 2H_2O$, $(UO_2)_2(OH)_2SO_42C_{10}H_8N_2 \cdot 2H_2O$, and $UO_2(OH)CH_3COOC_{10}H_8N_2$. Strong acid solutions were used in synthesizing the two compounds: $(C_{12}H_8N_2H)_2[UO_2Cl_4]$ and $(C_{10}H_8N_2H)_2[UO_2(CH_3COO)Cl_3$. The quantitative separation of uranium from acetic acid solutions by precipitation with 1, 10-phenanthroline is achieved in the form $UO_2(OH)CH_3COO \cdot C_{12}H_8N_2$. (R.V.J.)

5347 SPECTROPHOTOMETRIC STUDIES OF NEODYMIUM COMPLEXING WITH BISACETYLACETONETHYLENEDIAMINE. K. V. Astakhov, V. B. Verenikin, and V. I. Zimin. Zhur. Neorg. Khim., 6: 2077-81(Sept. 1961). (In Russian)

Absorption spectra of aqueous solutions of bis-acetylacetonethylenediamine, chloride, neodymium, and their mixtures were studied. Complexing between neodymium and bis-acetylacetonethylenediamine ions was observed, and it was found that between pH 1.0 to 7.0 the complexing occurs without splitting protons from the bis-acetylacetonethylenediamine molecule. It is shown that neodymium ions react with bis-acetylacetonethylenediamine to form one complex compound with a stability constant of 3.2×10^{-2}. The neodymium ion coordinates one bis-acetylacetonethylenediamine molecule. The possibility of complex compounds of neodymium and bis-acetylacetonethylenediamine is postulated. (R.V.J.)

5348 MELTING OF BINARY CESIUM AND SODIUM HALIDE SYSTEMS. R. G. Samuseva and V. E. Plyushchev (Moscow Inst. of Fine Chemical Tech.). Zhur. Neorg. Khim., 6: 2139-41(Sept. 1961). (In Russian)

Thermal analyses were made of the melting of binary systems formed by sodium and cesium halides. All systems of NaHal−CsHal are eutectic. The eutectic points were found for NaCl−CsCl with 34.5 mole % NaCl at 490°, NaBr−CsBr with 37.5 mole % NaBr at 460°, NaI−CsI with 45 mole % NaI at 435°, and NaF−CsF with 20 mole % NaF at 615°. (R.V.J.)

5349 THERMAL ANALYSIS OF $KF-LaF_3-K_2BeF_3$. Ch'u-tsu Hu and A. V. Novoselova. Zhur. Neorg. Khim., 6: 2148-57(Sept. 1961). (In Russian)

Five fields were observed on the liquidus surface of $KF-LaF_3-K_2BeF_4$; three belonged to LaF_3, KF, and K_2BeF

and two to the incongruently melting compounds $KLaF_4$ and K_3BeF_5. Eutectic points of 78% KF, 17% LaF_3, and 5% BeF_2 were found at 610 ± 5°, and peritectic points corresponding to 67.5% KF, 16% LaF_3, and 16.5% BeF_2 and 71% KF, 16.5% LaF_3, and 12.5% BeF_2 were found at 722 ± 5° and 667 ± 5°. (R.V.J.)

5350 FORMATION REACTION OF CERIUM HYDROXIDE. N. N. Mironov and N. P. Chernyaev. Zhur. Neorg. Khim., 6: 2163-72(Sept. 1961). (In Russian)

Effects of various anions and oxygen on the formation of cerium hydroxide were studied. It is shown that cerium sulfate has a greater tendency of forming basic salts than cerium chloride on nitrate. The following basic salts were formed in cerium salt reactions with caustic soda: $Ce(OH)SO_4$, $Ce_4(OH)_6(SO_4)_3$, $Ce_2(OH)_4SO_4$, $Ce_2(OH)_4SO_4 \cdot 2Ce(OH)_3$, $Ce(OH)_{2.5}Cl_{0.5}$, $Ce(OH)_{2.5}(NO_3)_{0.5}$, $Ce(OH)_{2.8}(NO_3)_{0.2}$, and $Ce(OH)_3$. The compositions of basic cerium sulfates formed at partial cerium oxidation by oxygen were also found. (R.V.J.)

5351 FORMATION OF LANTHANUM HYDROXIDE. N. N. Mironov and N. P. Chernyaev. Zhur. Neorg. Khim., 6: 2173-9(Sept. 1961). (In Russian)

Formation of lanthanum hydroxide from sulfate, chloride, and nitrate solutions was investigated at 25° using measurements and electric conductivity. It was observed that the formation of lanthanum hydroxide preceeds basic salt formation. Lanthanum sulfate shows a greater tendency to forming basic salts. Lanthanum salts react with caustic soda to form basic salts of the following composition: $La_2(SO_4)_3 \cdot 2La(OH)_3$, $La_2(OH)_4SO_4$, $La_2(OH)_4SO_4 \cdot 2La(OH)_3$, $La_2(SO_4)_3 \cdot 2La(OH)SO_4$, $La(OH)_{2.5}Cl_{0.5}$ $La(OH)_2Cl$, $La(OH)_{2.5}(NO_3)_{0.5}$, $La(OH)_2NO_3$, $2La(OH)_2NO_3 \cdot 3La(OH)_3$, $La(OH)_{2.8}(NO_3)_{0.2}$, and $La(OH)_3$. (R.V.J.)

5352 REACTION OF $ZrTiO_4$ WITH METAL OXIDES OF ELEMENTS OF MENDELEEV GROUPS II, III, AND IV AT ELEVATED TEMPERATURES. L. P. Mudrolyubova. Zhur. Priklad. Khim., 34: 1679-90(Aug. 1961). (In Russian)

Zirconium titanates mixed with other crystalline compounds disintegrate during heating. Only celsian, anorthite, gahnite, magnesium titanates, and beryllium oxides do not react with $ZrTiO_4$ and form mechanical mixtures. The other compounds disintegrated $ZrTiO_4$ separating monoclinic or cubical ZrO_2. Dielectric penetration and temperature coefficients of mixtures of $ZrTiO_4-BaO \cdot Al_2O_3 \cdot 2SiO_2$ and $ZrTiO_4-ZrO \cdot Al_2O_3$ vary with the change in component concentrations. Dielectric losses are visually small. (R.V.J.)

5353 KINETICS OF URANIUM OXIDE DISSOCIATION. V. G. Vlasov and A. G. Lebedeva. Zhur. Priklad. Khim., 34: 1739-44(Aug. 1961). (In Russian)

Reaction kinetics and dissociation processes were studied in uranium trioxide at 450 to 550°C and triuranium octoxide at 700 to 1000°C. The activation energy in uranium trioxide, triuranium octoxide, and $UO_{2.55}$ phase dissociation processes are 37.2, 25.3, and 12.4 kcal/mole, respectively. (R.V.J.)

5354 ELECTROCHEMICAL PREPARATION OF HIGH-PURITY CADMIUM. D. P. Zosimovich, K. B. Kladnitskaya, and A. N. Grisevich. Zhur. Priklad. Khim., 34: 1764-9(Aug. 1961). (In Russian)

Preparation of high-purity cadmium by electrolytic refining followed by separation of electrolyte from metal admixtures is described. (R.V.J.)

5355 ELECTRON-MICROSCOPIC AND THERMOGRAPHIC INVESTIGATION OF SOLID PHASE REACTIONS IN HfO_2-BaO, HfO_2-SrO, AND HfO_2-CaO. E. K. Keler, N. A. Godina, and M. G. Degen. Zhur. Priklad. Khim., 34: 1769-75(Aug. 1961). (In Russian)

The reactions of HfO_2 with $BaCO_3$, $SrCO_3$, and $CaCO_3$ at 1000 to 1200°C produced highly porous and friable compounds $BaHfO_3$, $SrHfO_3$, and $CaHfO_3$. The reaction products scale off the surface exposing the HfO_2 grains. The rate of the reaction is determined by the rate of chemical reaction with the diffusion surface. (R.V.J.)

5356 SYNTHESIS AND PHYSICO-TECHNICAL PROPERTIES OF STRONTIUM AND BARIUM ZIRCONATES. E. K. Keler and A. K. Kuznetsov. Zhur. Priklad. Khim., 34: 2146-53(Oct. 1961). (In Russian)

The formation of $SrZrO_3$ begins at 900°C and of $BaZrO_3$ at 600°C. The intense strontium zirconate formation takes place at 900 to 1200°C and barium zirconate at 900 to 1050°C. The specimens of $SrZrO_3$ and $BaZrO_3$ have increased volume and porosity. Additions of B_2O_3 reduced the sintering temperature (~200°C) of these zirconates and improved their physico-technical properties. (R.V.J.)

5357 ELECTROCHEMISTRY OF MOLTEN AND SOLID ELECTROLYTES. (Elektrokhimiya Rasplavlennykh Solevykh i Tverdykh Elektrolitov). (In English Translation). New York, Consultants Bureau, Inc., 1961. 112p. $17.50.

Translations are presented of 20 articles on high-temperature electrochemistry of molten and solid electrolytes. Topics covered include problems of kinetics and thermodynamics of electrode processes during electrolysis of molten salts and the structure of ionic molten salts. New data are presented on the behavior of anodes of carbon and the oxides of some rare metals in molten halides. The role of oxygen in molten electrolytes during electrolytic precipitation of Nb and some rare earths is clarified. Data are included on the electrical conductivity of molten Na and K carbonates and their mixtures. A new method is described for determining corrosion by molten salts. Among the problems discussed concerning solid electrolytes are the electromotive forces of electrochemical cells with solid electrolytes. A number of methods are considered for investigating the decomposition potentials of electrolytes composed of solid solutions. The electrical conductivity and the nature of the conductivity of a number of oxide systems are discussed. A new method is presented for investigating the nature of conductivity of solid oxides. Separate abstracts were prepared on 7 selected papers. (C.H.)

5358 RESIDUAL CURRENTS AND CATHODIC DEPOSITION OF METALS FROM MOLTEN SALTS. M. V. Smirnov. p.3-5 of "Electrochemistry of Molten and Solid Electrolytes." New York, Consultants Bureau, Inc., [1961].

The nature of residual currents was investigated and an equation is presented for expressing the case of cathodic deposition of metals from molten salts. The variation of cathodic yield was determined as a function of temperature and concentration for the case of electrolysis of molten salts. The electrolysis of mixed molten chlorides containing Th and the electrolytic deposition of Be from molten chloride mixtures at temperatures above 600°C are given as examples. The data are said to be applicable also to electrolytic deposition of many multivalent metals such as Ti, Zr, Hf, Th, U, Nb, and Ta in molten salt mixtures. (C.H.)

5359 PERIOD OF TIME NECESSARY TO ESTABLISH A STATIONARY STATE IN ELECTROLYSIS WITH A CON-

STANT INTENSITY OF CURRENT. A. N. Baraboshkin and M. V. Smirnov. p.6-15 of "Electrochemistry of Molten and Solid Electrolytes." New York, Consultants Bureau, Inc., [1961].

Results are reported from studies on the electrolysis of molten salts at temperatures above 500°C. Equations were derived for the period of time necessary to reach the stationary state for anodic and cathodic processes. It is shown that there is a qualitative agreement between the theoretical and experimental relationships. (C.H.)

5360 EQUILIBRIUM POTENTIALS OF ZIRCONIUM IN MOLTEN EQUIMOLAR MIXTURE OF SODIUM AND POTASSIUM CHLORIDES. V. E. Komarov, M. V. Smirnov, and A. N. Baraboshkin. p.16-21 of "Electrochemistry of Molten and Solid Electrolytes." New York, Consultants Bureau, Inc., [1961].

Measurements were made of the equilibrium potentials of Zr in molten equimolar mixtures of NaCl and KCl containing 0.16 to 6.8% Zr by weight at the temperature range of 687 to 978°C. It was found that when Li^+ ions were replaced by Na^+ ions the equilibrium potential of Zr is displaced toward more negative values and the heats of formation of di- and tetrachlorides of Zr dissolved in molten mixtures of chlorides of alkaline metals are increased. The temperature dependencies of the constants involved in the thermodynamic equations of electrode potentials were determined. The heat of solution of $ZrCl_4$ and the heat of formation of $ZrCl_6^{2-}$ complex ions in molten NaCl + KCl were determined. (C.H.)

5361 ELECTRODE PROCESSES AND THE EFFECT OF OXYGEN DURING ELECTROLYTIC DEPOSITION OF COLUMBIUM FROM POTASSIUM FLUOROCOLUMBATE. L. E. Ivanovskii and M. T. Krasil'nikov. p.41-5 of "Electrochemistry of Molten and Solid Electrolytes." New York, Consultants Bureau, Inc., [1961].

The polarization of a Mo cathode in molten sodium chlorides containing 5, 10, 20, and 30% potassium fluoroniobate was investigated at 850°C and current densities varying from 10^{-3} to 6 amp/cm^2. It was found that several processes occur on the cathode as the current density is increased. At low current densities, Nb ions pass from high to low valence. At high current densities, a metallic Nb is deposited first, and then the alkali metal is deposited. The polarization of a graphite anode was investigated in pure molten NaCl and in molten NaCl containing 10% K_2NbF_7 by weight. The polarization curve had two distinct regions. The first region apparently corresponds to the process of change of charge of ions, and the second to the discharge of O with the formation of CO_2. The cathodic deposition obtained during electrolysis of molten NaCl containing 15% K_2NbF_7 by weight was analyzed. It was shown that either a metal or a mixture of oxides is deposited on the cathode according to the conditions of the experiment. The possibility of the formation of oxygen-containing ions in the molten electrolyte and their behavior during electrolysis is discussed. (C.H.)

5362 LOW-VALENT RARE EARTH OXYCHLORIDES. L. E. Ivanovskii, N. G. Ilyushchenko, V. L. Zyazev, and A. F. Plekhanov. p.46-50 of "Electrochemistry of Molten and Solid Electrolytes." New York, Consultants Bureau, Inc., [1961].

The interaction between a mixture of rare earth chlorides and misch metal in the presence of oxygen was investigated. A mixture of low-valent oxychlorides, Me_2OCl_2, was isolated where Me is La, Ce, Pr, or Nd. Some of the properties of the mixtures were investigated. It was shown that during electrolysis of molten chlorides, where contact with humidity and oxygen from the air was not excluded, oxycations of the $Me_2OCl_2^{2+}$ type apparently formed as the result of oxidation of the salts. The discharge of these oxycations on the cathode led to the formation of oxychlorides of low valence, Me_2OCl_2. The anodic dissolution of misch metal was also investigated. During its dissolution in molten rare earth chlorides, divalent chlorides of rare earth are formed in the electrolyte, and the interaction of these chlorides with oxygen leads also to the formation of oxychlorides of the same composition. (C.H.)

5363 ELECTRICAL CONDUCTIVITY OF SYSTEMS OF SOLID OXIDES. II. THE ZrO_2-CaO SYSTEM. ELECTRICAL CONDUCTIVITY AND TRANSPORT NUMBERS. Z. S. Volchenkova and S. F. Pal'guev. p.97-103 of "Electrochemistry of Molten and Solid Electrolytes." New York, Consultants Bureau, Inc., [1961].

The structural components and ceramic properties of different compositions of the ZrO_2-CaO system were investigated. It was found that when the concentration of CaO is between 10 and 40 mole % at 1500°C the solid solutions formed have good ceramic properties. The temperature dependence of the electrical conductivity of samples of different compositions of the ZrO_2-CaO system was determined and the activation energies of electrical conductivity were calculated. Solid solutions containing 10 to 20 mole % CaO were found to have maximum electrical conductivity. The crystal structure of this system of oxides was found to influence the specific electrical conductivity and the activation energy of electrical conductivity. The ion transport numbers of solid solutions of this system were investigated. Results are discussed in the light of the possibility of applying the gravimetric method to the measurement of ion transport numbers in oxide systems. (C.H.)

5364 ELECTRICAL CONDUCTIVITY OF SOLID OXIDES. III. THE ThO_2-CaO SYSTEM. Z. S. Volchenkova and S. F. Pal'guev. p.104-6 of "Electrochemistry of molten and Solid Electrolytes." New York, Consultants Bureau, Inc., [1961].

The electrical conductivity and ceramic properties of ThO_2-CaO samples were investigated for different compositions fired at 1550 ± 20°C for one hr. The results of measurements indicate that the structure formed under these firing conditions determines the electrical properties of the samples. (C.H.)

5365 METHOD OF MAKING UO_2-Bi SLURRIES. Australian Patent 228,249. Feb. 3, 1959.

A process is given for preparing an easily dispersible slurry of uranium dioxide in bismuth. A mixture of bismuth oxide, uranium, and bismuth are heated in a capsule to a temperature over the melting point of bismuth oxide. The amount of bismuth oxide used is less than that stoichiometrically required because the oxygen in the capsule also enters into the reaction.

5366 CROSS-LINKED ALPHA-OLEFIN POLYMERS AND PROCESS FOR PREPARING THEM. (to Montecatini Societa Generale per l'Industria Mineraria e Chemica). British Patent 885,470. Dec. 28, 1961.

Crystalline alpha olefin polymers and copolymers containing tertiary carbon atoms can be crosslinked without irradiation to yield products having good mechanical properties at temperatures above the complete melting point of the non-crosslinked polymers. The crosslinking process comprises heating to 120 to 200°C a mixture of a linear, isotactic alpha olefin polymer, a substance containing at least one vinylidene ($CH_2 = C\langle$) group in the molecule, and an organic peroxy compound which yields free radicals at that temperature. The olefin may be propylene or butene-1, and the substance containing vinylidene groups may be styrene, divinylbenzene, butadiene, etc. The process alters only the mechanical properties of the polymers, leaving the physical properties unchanged; its advantage over the irradiation process is that expense of radiation sources and possible degradation of the polymers are avoided. (D.L.C.)

Radiation Chemistry and Radiochemistry

Refer also to abstracts 5229, 5231, 5234, 5235, 5236, 5237, 5238, 5239, 5241, 5243, 5247, 5248, 5249, 5250, 5251, 5253, 5254, 5255, 5256, 5258, 5259, 5260, 5262, and 5766

5367 (AERE-C/R-2441) THE DEPOSITION OF THIN FILMS OF RADIOACTIVE MATERIALS BY VACUUM EVAPORATION. E. Furby and K. L. Wilkinson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1958. 13p.

An apparatus for depositing, on platinum or aluminum substrates, nearly uniform, adherent films of uranium or plutonium by high temperature and low pressure evaporation is described. Progress during evaporation can be observed quantivatively and deposits of up to 2.8 mgms U/cm^2 were obtained. Initial successes with plutonium are noted. High frequency heating is employed and the equipment is installed in glove boxes. (auth)

5368 (APEX-180) HTRE HAZARDS REPORT. Carl C. Gamertsfelder, ed. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 15, 1954. Decl. June 16, 1961. Contract [AT(11-1)-171]. 169p.

A detailed description is given of the Heat Transfer Reactor Experiment (HTRE) site, facilities, and reactor. Included are descriptions of the HTRE power plant and control system, the reactor assembly, the fuel cartridge assembly, the HTRE nuclear and thermodynamic characteristics, the reactor design characteristics, reactor operation and startup procedure, and reactor emergencies. A detailed analysis of the hazards connected with the HTRE is then given. Reactor runaways are discussed, including a summary of runaway results, methods of calculation, and a comparison of runaways resulting from various reactivity increases. Calculations of hazards to the surrounding area are given for major releases of activity and for airborne contamination during normal operation. Appendices include detailed descriptions of the Core Test Facility, the reactor control system, and the hydrology, geology, and population distribution of the National Reactor Testing Station area, and the application of Sutton's diffusion equations to radiation. (C.H.)

5369 (NAS-NS-3049) THE RADIOCHEMISTRY OF SILICON. W. T. Mullins and G. W. Leddicotte (Oak Ridge National Lab.). 1961. 37p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A review is presented of the chemical and nuclear features of interest to the radiochemist, and problems in counting techniques and sample dissolution. A collection of radiochemical procedures for the element as found in the literature are included. (B.O.G.)

5370 (TID-14441) EFFECTS OF MERCAPTANS AND DISULFIDES ON FREE RADICAL, LIGHT AND HIGH ENERGY RADIATION INDUCED REACTIONS. Progress Report for Period November 1, 1960–November 1, 1961. Saul G. Cohen (Brandeis Univ., Waltham, Mass.). Dec. 8, 1961. Contract AT(30-1)-2499. 28p.

The photochemical conversion of benzophenone in 2-propanol to benzopinacol and acetone is retarded and inhibited by certain mercaptans and disulfides present in low concentration. The retarded reactions start at time zero and proceed at constant rate with zero order kinetics. Inhibition does not lead to consumption of the inhibitor, initially present mercaptan or disulfide being converted to an equilibrium mixture of the two. An inhibited reaction carried out in (+) 2-octanol leads to racemization; irradiation of (+) 2-octanol with benzophenone or disulfide separately does not lead to racemization. Inhibition results from repeated reaction of the sulfur compounds in their two valence states with the normal free radical intermediates, the sulfur compounds being converted to their alternate, still reactive, valence states, the radicals being converted to the starting materials. The Co^{60} γ-ray induced conversion of benzophenone to benzopinacol in 2-propanol is also inhibited by mercaptans and disulfides, presumably for a similar mechanism. (auth)

5371 (UCRL-9846) STUDIES OF FAST EXCHANGE REACTIONS BY THE USE OF NUCLEAR MAGNETIC RESONANCE. PART I. IODINE EXCHANGE IN AQUEOUS TRIIODIDE SOLUTIONS. PART II. EXCHANGE OF COORDINATED WATER MOLECULES IN AQUEOUS FERRIC SOLUTIONS (thesis). Edward Easley Genser (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 1962. Contract W-7405-Eng-48. 100p.

The exchange of iodine nuclei between the bulk iodide ions and aqueous triiodide ion is shown from measurements of the concentration and temperature dependence of the nuclear magnetic resonance line width of I^{127} to be consistent with the bimolecular process $I^{-*} + I_3^- \underset{k_2}{\overset{k_2}{\rightleftharpoons}} I_3^{-*} + I^-$. The value of k$_2$ at 27°C is $2.2 \pm 0.4 \times 10^9$ $\underline{M}^{-1}$ sec^{-1}. The values of the heat and entropy of activation obtained are $\Delta H_2^\ddagger = 4.5 \pm 1.5$ kcal, $\Delta S_2^\ddagger = -0.7 \pm 5.0$ cal deg^{-1} mole^{-1} at 27°C. At room temperature and intermediate iodide concentrations the line width was dominated by the relaxation process $I_3^{-*} \xrightarrow{k_4} I_3^-$. The constant k$_4$, the inverse relaxation time for this process, is related to the quadrupole coupling constant of this species. The exchange of water molecules between the first coordination sphere of ferric ion and the solvent water is shown from the temperature dependence of the relaxation time T$_2$ of O^{17} to be directly measurable. The lifetime of a coordinated water molecule is limited by the exchange $Fe(H_2O)^{+3} + H_2O^* \rightleftharpoons Fe(H_2O^*)^{+3} + H_2O$. The reciprocal lifetime $1/\tau_p$ for a coordinated water molecule is $1/\tau_p = 3.0 \times 10^3$ sec^{-1} at 27°C. The corresponding heat and entropy of activation are $\Delta H^\ddagger = 8.9 \pm 1.0$ kcal and $\Delta S_p^\ddagger = -13 \pm 4$ cal deg^{-1} mole^{-1} at 27°C. (auth)

5372 (CEA-tr-R-1339) PREPARATION DE L'YTTRIUM-90 SANS ENTRAINEUR, A L'ETAT DE PURETE RADIOCHIMIQUE. (Preparation of Carrier-Free Yttrium-90 in a State of Radiochemical Purity). N. P. Rudenko. Translated into French from Zhur. Neorg. Khim., 4: 220-4(1959). 16p.

The chromatographic, electrolytic, and nitrate precipitation methods for the preparation of carrier-free yttrium-90 are described, and their advantages and disadvantages are discussed. An extraction method for carrier-free Y^{90} and its solutions with strontium was developed as a result of research on the formation conditions and chloroform extraction of yttrium 8-oxyquinoleinate.

This complex is soluble in organic solvents and stable in aqueous solutions at pH values at which strontium does not react with 8-oxyquinoleine. The details of the procedure are given. (J.S.R.)

5373 (CEA-tr-R-1398) NOTIONS FONDAMENTALES DE RADIOCHIMIE. CHAPITRE IV. ELECTROCHIMIE DES MATERIAUX RADIOACTIFS. (Fundamental Ideas of Radiochemistry. Chapter IV. Electrochemistry of Radioactive Materials). I. E. Starik. Translated into French from p.381-448, Chap. IV of "Elektrokhimiya Radioaktivnykh Veshchestv," (Work No. C-290). 132p.

In the study of radiochemistry two factors are of great importance: the secondary reactions caused by the radiations of the radioisotope and the usually very low concentration of the radioisotope. After a discussion of these factors, a review is given of the electrochemical separation of radioisotopes by the use of an external electromotive force, kinetics of electrochemical processes, application of the Nernst equation to the case of the electrochemical precipitation of microquantities of radioisotopes and in particular polonium, bismuth, silver, zinc, protactinium, and tellurium, electrochemical separation of radioactive substances without use of external electromotive force, practical utilization of the spontaneous separation method, electrochemical separation of radioisotopes on precious metals without the use of external electromotive force, and methods for the electrochemical separation of radioisotopes more electronegative than hydrogen. 76 references. (J.S.R.)

5374 (CEA-tr-R-1402) ETUDE DES REACTIONS DES RADICAUX LIBRES, DANS LE POLYTETRAFLUORETHYLENE IRRADIE. II. DETERMINATION DES CONSTANTES DES VITESSES DE REACTIONS SUIVANTES: $\dot{R}O_2 \rightarrow \dot{R} + O_2$ ET $\dot{R} + O_2 \rightarrow \dot{R}O_2$. (Study of Reactions of Free Radicals in Irradiated Polytetrafluoroethylene. II. Determination of Reaction Rate Constants According to: $\dot{R}O_2 \rightarrow \dot{R} + O_2$ and $\dot{R} + O_2 \rightarrow \dot{R}O_2$). Yu. D. Tsvetkov (Ju. D. Cvetkov), Ya. (Ja.) S. Lebedev, and V. V. Voevodskii (Voevodskij). Translated into French from Vysokomolekulyarnye Soedineniya, 1: 1634-42(1959). 28p. (Includes original, 9p.).

Equilibrium between the radicals $\dot{R}$ and $\dot{R}O_2$ in irradiated polytetrafluoroethylene and the decomposition kinetics of $\dot{R}O_2$ were studied at various temperatures with the aid of the electron resonance method. An explanation of the shape of the kinetic curves was given with respect to the size of the specimen and the degree of conversion. Based on an analysis of the experimental data, calculations were made of the rate constants of the forward and reverse reactions as well as of the solubility constant of oxygen in teflon. (auth)

5375 (NP-tr-820) EXTRACTING RADIOACTIVE PHOSPHORUS 32 FROM TRIBUTYL PHOSPHATE BY NUCLEAR COUNTERCOLLISION IN THE TARGET. Hu-hou Li. Translated from K'o Hsueh T'ung Pao, No. 11, 364(June 11, 1959). 1p.

About 15 μc of P^{32} was prepared using 1 kg of TBP and irradiating it with neutrons from a few Curie mg of Po-Be for 7 days and nights, then absorbing them in 50 ml of distilled water. (M.C.G.)

5376 HIGH TEMPERATURE PILE IRRADIATION OF THE n-HEPTANE-HYDROGEN SYSTEM. George H. Miley and Joseph J. Martin (Univ. of Michigan, Ann Arbor). A.I.Ch. E. Journal, 7: 593-8(Dec. 1961).

A pilot unit for the high-temperature irradiation of flowing reactants was designed for the beam part of a nuclear reactor. Radiation-thermal cracking of the n-heptane-hydrogen system was studied with molal H_2/C_7 ratios from 0 to 5 at 250 lb/sq in., 600 to 750°F, 2 to 8 min residence time, and up to 3,600 rep/min. Although conversions were low, the decomposition rate was significantly increased by radiation giving G values > 10^3. Product distributions were not significantly altered by radiation. These results, while different from low-temperature data, appear consistent with other published high-temperature results. Radiation yields were found to be reasonably linear with total dose from 0 to 14 krep, but a twofold increase was observed in passing from a molal H_2/C_7 ratio of 0 to 0.5. (auth)

5377 ELECTRON PARAMAGNETIC RESONANCE IN γ-IRRADIATED FERROELECTRIC $LiH_3(SeO_3)_2$. R. Blinc, S. Detoni, M. Pintar, and S. Poberaj (J. Stefan Inst., Ljubljana, Yugoslavia and Univ. of Ljubljana, Yugoslavia). Croat. Chem. Acta, 33: No. 2, 89-92(1961). (In English)

The electron paramagnetic resonance absorption spectra are obtained for various orientations of ferroelectric $LiH_3(SeO_3)_2$ monocrystals at room temperature. The samples are exposed to gamma radiation from a cobalt-60 source and receive doses of 10^6 r. Strong anisotropy of the electron paramagnetic resonance absorption is evident, and the results taken immediately after irradiation and those after two months are the same. The observed spectra indicate that stable defects fixed in the crystal lattice are produced by the irradiation. (N.W.R.)

5378 THE RADIATION SYNTHESIS OF NEW, HETEROCYCLIC DERIVATIVES. S. A. Safarov, M. A. Proskurnin, and B. F. Bogatikov (Karpov Physics-Chemistry Inst., USSR). Doklady Akad. Nauk S.S.S.R., 140: 1345-7(Oct. 21, 1961). (In Russian)

Dilute solutions of thiophene-water and of furan-water (1 : 1000) were irradiated with Co^{60} at dose rates of 8 to 648 r/sec. The simultaneous occurrence of OH and H radicals led to the formation of dimers with a hydrogenated nucleus in one part of the molecule and an oxidized nucleus in the other part of the molecular dimer. The H and OH radicals first react with thiophene to form organic radicals as follows: 1) $C_4H_4S + H^* \rightarrow C_4H_5S^*$ and 2) $C_4H_4S + OH^* \rightarrow C_4H_4OHS^*$. The organic radicals from 1) and 2) then react to form the dimer: 3) $C_4H_4S^* + C_4H_4OHS^* \rightarrow SC_4H_5-C_4H_4OHS$. The ultra-violet absorption spectra and the results of analyses for C, H, S and O are in agreement with the above mechanism. An analogous behavior was observed in the furan-water system. (TTT)

5379 THE RADIATION CONVERSION OF FERROUS AND FERRIC IONS IN $HClO_4$ SOLUTIONS SATURATED WITH HYDROGEN AND OXYGEN UNDER PRESSURE. V. N. Shubin and P. I. Dolin (Inst. of Electrochemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 140: 1380-3(Oct. 21, 1961). (In Russian)

The following radiolytic oxidation reactions take place in a Fe^{2+} solution in the presence of O_2: 1) $H + O_2 \rightarrow HO_2$; 2) $HO_2 + Fe^{2+} \rightarrow Fe^{3+} + HO_2^-$; 3) $HO_2^- + H^+ \rightarrow H_2O_2$; 4) $H_2O_2 + Fe^{2+} \rightarrow Fe^{3+} + OH^- + OH$; 5) $OH + Fe^{2+} \rightarrow Fe^{3+} + OH^-$. In the presence of Fe^{3+} it is also assumed that the following reactions take place: 6) $H + Fe^{3+} \rightarrow Fe^{2+} + H^+$; 7) $HO_2 \rightleftharpoons H^+ + O_2^-$; 8) $O_2^- + Fe^{3+} \rightarrow Fe^{2+} + O_2$. It has been proposed that reactions 2) and 3) be replaced by the following reaction: 9) $2HO_2 \rightarrow H_2O_2 + O_2$. The following reaction also takes place: 10) $OH + H_2 \rightarrow H_2O + H$. Reaction 9) is eliminated from consideration, since it has been found that G (Fe^{3+}) depends strongly on [Fe^{2+}] at a constant value of [Fe^{2+}]/[H_2]. On the basis of reactions 1) to 8) and reaction 10), an expression is derived that relates the radiation yields with the reaction rates of the competing reactions. By determining G (Fe^{3+}) as a function of the concentrations of O_2 and of Fe^{3+} it is found that $k_6/k_1 = 2.45 \times 10^{-2}$ and that $(k_8\ K_{H_2O})/k_2 = 3.1 \times 10^{-8}$ mols/1. By determining the yield of Fe^{3+} as a function of the concentration of H^+, Fe^{2+} and Fe^{3+} at $[Fe^{3+}]/[O_2]$ = constant, it is found that $(k_8\ K_{HO_2})/k_2 = 3.6 \times 10^{-8}$ mols/l. These results agree with those of Allen on introducing a correction for the complexing of Fe^{3+} by sulfate. The yield of Fe^{3+} was determined as a function of O_2 pressure in a solution 0.1 M in $HClO_4$, 8×10^{-3} M in Fe^{3+}, 1.2×10^{-3} M in Fe^{2+} and a H_2 pressure = 50 atm. The yield increases with increasing O_2 pressure due to suppression of reaction 6) by reaction 1), but the yield becomes constant at an O_2 pressure of about 10 atm and remains constant up to an O_2 pressure of 150 atm. These results show that excited water molecules are not involved in the oxidation of Fe^{2+}. All the data on the radiolysis of Fe^{2+} and Fe^{3+} solution in the presence of O_2 and H_2 can be quantitatively described by reactions 1) to 8) and reaction 10). (TTT)

5380 SURFACE AREA MEASUREMENT BY THE SORPTION OF STEARIC ACID-1-CARBON-14. M. C. Kordecki and M. B. Gandy (Georgia Inst. of Tech., Atlanta). Intern. J. Appl. Radiation and Isotopes, 12: 27-31(Nov. 1961). (In English)

A technique was developed for determining the surface area of non-porous powders by their sorption of stearic acid-1-carbon-14 from benzene solutions. Aliquots of the initial solution and of the solution in equilibrium with a sample were plated on chilled watch glasses and assayed by thin end-window Geiger counters. Specific surface areas obtained by this method for low-surface powders compared favorably with nitrogen-adsorption values (BET method). Results reported (in square meters per gram) are 21.1 for clay, 4.7 and 6.3 for two zinc oxides, 3.6 for alumina, 21.4 for calcium sulfate, 22.3 for nickel, 0.6 for glass beads, 6.5 for titania, 4.0 and 10.2 for two ferric oxides, 5.5 for zinc carbonate, 50.1 for manganese dioxide, 6.0 for manganous chloride, and values of 4.0, 3.9 and 3.4 for zinc sulfide. The BET values for these powders were 19.8, 4.7 and 6.1, 3.4, 17.9, 24.9, 0.4, 7.7, 4.2 and 10.1, 4.9, 44.8, 5.8 and 3.7 m^2/g, respectively. (auth)

5381 AN IMPROVED GALLIUM-68 COW. M. W. Greene and W. D. Tucker (Brookhaven National Lab., Upton, N. Y.). Intern. J. Appl. Radiation and Isotopes, 12: 62-3(Nov. 1961). (BNL-5455). (In English)

The generator and method for milking (cow) 68-min gallium-68 from its 290-day germanium-68 parent are described. The generator consists of a glass column 25 mm in diameter containing 10 g of chromatographic alumina held on a course fritted glass disc and retained at the top by a piece of filter cloth and a polyethylene split washer. The germanium-68 activity is placed on the column in a solution of 0.005 M EDTA, the pH of which is adjusted to 7 with dilute NaOH. The generator is milked by pouring 25 mil of neutral 0.005 M EDTA solution into the column and allowing it to pass down through the alumina under its own head. This takes about 3 to 4 min. The germanium-68 is retained by the alumina, probably as an anion, while gallium-68 is removed as an EDTA complex. The yield is about 70% of the gallium-68 on the column, and the product is carrier-free. (N.W.R.)

5382 LIQUID SCINTILLATION COUNTING OF NICKEL-63. C. E. Gleit and J. Dumot (Westinghouse Electric Corp., Pittsburgh). Intern. J. Appl. Radiation and Isotopes, 12: 66(Nov. 1961). (In English)

Liquid scintillation systems based on gels, ether, and toluene are investigated for counting nickel-63. A nickel complex of n-caproic acid dissolved in a solution of toluene containing 1,4-bis(2-(5-phenyloxazolyl))-benzene (POPOP) and 2,5-diphenyloxazole (PPO) is found to be preferable with respect to reproducibility, ease of preparation, and interpretation. The addition of a small quantity of ethyl alcohol produces a slight loss of efficiency but stabilizes the solution in the presence of residual water. The method for preparing the sample is described. The results show that count rate increases with decreasing temperature. (N.W.R.)

5383 THE PREPARATION OF CARRIER-FREE SILVER-111. D. M. Taylor (Royal Cancer Hospital, London). Intern. J. Appl. Radiation and Isotopes, 12: 66-7(Nov. 1961). (In English)

An ion exchange procedure by means of which a radiochemically pure, carrier-free solution of silver-111 may be prepared from neutron irradiated palladium in about two hours is described. Palladium metal (0.1 g), after irradiation for 4 to 6 days in a neutron flux of $10^{12}n/cm^2/sec^{-1}$, is dissolved in aqua regia and the resulting solution is evaporated to dryness. After heating to drive off the remaining traces of nitric acid, the residue is dissolved in a small volume of 10 M hydrochloric acid and placed on a column (dia. 1 cm, length 25 cm) of the anion exchange resin Deacidite FF. The silver-111 is then washed off the column with 50 ml of 10 M hydrochloric acid. The hydrochloric acid solution is evaporated to dryness and the residue dissolved in dilute nitric acid. (N.W.R.)

5384 RADIATION-INDUCED GRAFT POLYMERIZATION: THE TROMMSDORFF EFFECT OF METHANOL. George Odian, Marjorie Sobel, Albert Rossi, and Robert Klein (Radiation Applications Inc., Long Island City, N. Y.). J. Polymer Sci., 55: 663-73(Dec. 1961).

The radioinduced graft polymerization of styrene to low density polyethylene was investigated. It was found that dilution of the styrene monomer with methanol accelerates the rate of graft polymerization with a maximum effect occurring at approximately 70 vol % methanol. Both the accelerated and unaccelerated graft polymerizations yield volumetric or homogeneous graft copolymers. Experiments in which n-octane was substituted for methanol as the diluent showed that the accelerative effects of methanol are best explained by the incursion of a Trommsdorff-type effect. The k_p^2/k_t values for the grafting reaction in the various styrene–methanol solutions were calculated. It was found that the k_p^2/k_t term is larger in grafting than in homopolymerization by a factor of 10^3, and that it increases as the methanol concentration of the monomer solution increases. (auth)

5385 ELECTRON SPIN RESONANCE AND STRUCTURE OF THE IONIC RADICAL, $\cdot\ PO_3^=$. A. Horsfield, J. R. Morton, and D. H. Whiffen (National Physical Lab., Teddington, Middx., Eng.). Mol. Phys., 4: 475-80(Nov. 1961).

It is shown that the ionic radical, $\cdot PO_3^{2-}$, is formed by the action of γ rays on disodium ortho-phosphite pentahydrate. The hyperfine coupling to the P^{31} nucleus has principal values of 1967, 1514, and 1513 mc/s and is consistent with a pyramidal ion having OPO angles of 110°. (auth)

5386 PRODUCTION OF HIGH MOLECULAR WEIGHT PRODUCTS FROM THE IRRADIATION OF METHANE WITH 4-Mev ELECTRONS. R. W. Hummel (Atomic Energy Research Establishment, Wantage, Berks, Eng.). Nature, 192: 1178-9(Dec. 23, 1961).

Purified (99.98%) gaseous methane was irradiated with electrons from a linear accelerator. The dosimetry was based on the yield of ethane, G = 2.00, from methane after short irradiations. Irradiations giving up to 30% methane decomposition were carried out. Of the liquid product collected, only a small fraction (about 10%) was detectable by gas chromatography at 180°C, and consisted of C_6-C_{12} hydrocarbons. Analyses on a less sensitive apparatus showed that the major portion of the liquid consisted of C_{11} to C_{20} hydrocarbons. No hydrocarbons above pentanes were detected in the gaseous products. Irradiation of a methane–argon mixture containing 0.65 electron fraction argon gave essentially the same yield of liquid products as pure methane. The results indicate that a process occurs in irradiated methane which is enhanced in mixtures with argon, this process giving rise to both increased yields of high molecular weight products and molecular hydrogen. It appears likely that a non-radical process is responsible. (P.C.H.)

5387 ELECTRO-SPRAYING: A METHOD OF MAKING SAMPLES FOR β COUNTING ALLOWING ACCURATE CORRECTION FOR SELF-SCATTERING AND SELF-ABSORPTION. E. Bruninx and G. Rudstam (CERN, Geneva). Nuclear Instr. & Methods, 13: 131-40(Sept. 1961). (In English)

The different aspects of preparing thin, uniform samples by electro-spraying are described. The technique is used in the determination of a set of self-scattering and self-absorption factors for three different β emitters with low, medium, and high energy. A general method is outlined for the determination of these factors under different conditions. (auth)

5388 HYDROGEN AND CARBON TARGET PREPARATION FOR A POSITIVE ION ACCELERATOR. R. D. McCormick and J. D. McCormack (General Electric Co., Richland, Wash.). Nuclear Instr. & Methods, 13: 147-52 (Sept. 1961). (In English)

A detailed description is given of the techniques used to make hydrogen and carbon targets for the Hanford 2 Mev positive ion accelerator. The hydrogen targets were made by adsorbing deuterium or tritium onto either titanium or zirconium. These metals were mounted on their platinum and tantalum backing disks by evaporation or by sintering. Targets ranged in thickness from 200 to 15000 μg per square centimeter with atomic ratios of 1 to 1. Carbon targets were made by mounting carbon on platinum backing disks by evaporation, painting, or cracking. Targets ranged in thickness from 100 to 5000 μg per square centimeter. (auth)

5389 THE RADIATION-INDUCED EXCHANGE OF CHLORINE BETWEEN CHLORIDE AND TRICHLORACETIC ACID. R. D. Borie, Jr. and F. J. Johnston (Univ. of Louisville, Ky.). Radiation Research, 15: 724-33(Dec. 1961).

The radiation-induced decomposition of trichloroacetic acid may be qualitatively represented by the over-all reaction: $CCl_3COOH \xrightarrow{HOH} 3\ HCl + CO_2 + Y$. G values for chloride and CO_2 formation are 9.2 and 3, respectively, in acidic solutions to which no chloride has been added. The complete product spectrum was not determined. $G_{(Cl^-)}$ is larger in neutral solutions. With chloride present in the system, a radiation-induced exchange occurs with a G value of 1.7 in acid solutions and of 1.1 in neutral solutions. Several possibilities are mentioned for the exchange mechanisms. Results suggest that new information concerning intermediates in aqueous radiation chemistry might be obtained by similar exchange studies in other systems. (auth)

5390 THE RADIATION CHEMICAL CIS → TRANS REARRANGEMENT BY ENERGY TRANSFER. D. Schulte-Frohlinde and H. Guesten (Kernforschungszentrum, Karlsruhe, Ger.). Z. physik. Chem. (Frankfurt), 29: 281-3(Aug. 1961). (In German)

The secondary scintillator of a liquid organic scintillator was replaced by a photochemically active substance. The photoactive compound p-nitro-p′-methoxystilbene was used in benzene with and without the addition of terphenyl. The x-ray-induced cis → trans rearrangement of the stilbene was measured. The results are graphed and tabulated. They show that the energy of the primary scintillator was transferred to the p-nitro-p′-methoxystilbene by radiation. (J.S.R.)

5391 PROCESS FOR THE PRODUCTION OF POLYMERIC MATERIAL BY DISPERSION OR EMULSION POLYMERIZATION. John William Vanderhoff and Ralph McConnell Wiley (to Dow Chemical Co.). British Patent 884,782. Dec. 20, 1961.

The water-in-oil type emulsion polymerization process as described in British Patent 841,127 is modified in that the hydrophilic water-soluble unsaturated monomer is directly dispersed in the inert organic liquid, either in the absence of water or in the presence of small amounts of water. A suitable emulsifying agent is used in the proportion 0.1 to 10 wt %, and free radical-yielding agents or radiation may be used to cause the polymerization. (D.L.C.)

5392 IMPROVEMENTS IN OR RELATING TO POLYMERISATION OF TRANS-SUBSTITUTED ETHYLENES. William Hay Stafford, William Hunter Taylor, and William Miller. British Patent 884,999. Dec. 20, 1961.

The trans isomer of 1,2-dichlorethylene may be polymerized by the action of ionizing radiation to give solid high polymers having a very high melting point and high stability. The radiation may be gammas or electrons of energy at least 1 Mev, and the irradiation may be carried out in the temperature range −48 to +48°C. The cis isomer is not polymerized appreciably under these conditions. (D.L.C.)

5393 IMPROVEMENTS RELATING TO PHOTOPOLYMERIZATION OF VINYL MONOMERS. (to General Aniline & Film Corp.). British Patent 885,128. Dec. 20, 1961.

The rate at which vinyl monomers may be photopolymerized may be greatly increased if a catalyst is used comprising a mixture of an insoluble silver halide; a relatively soluble silver salt; one of the compounds ZnO, ZrO_2, TiO_2, and SiO_2; and an optical sensitizing dye. A crosslinking agent may also be used to improve the properties of the final polymer. The radiation used to initiate the reaction is in the 10^{-1} to 10^{-10} cm range. (D.L.C.)

5394 METHOD OF NUCLEAR TRANSMUTATION OF THE CHEMICAL ELEMENTS. A. Goschler. French Patent 1,218,965. Dec. 21, 1959.

In an arc discharge and/or by irradiation a definite number of electrons are removed from the electron clouds of atoms; this should bring about transmutation of the nuclei. (NPO)

Raw Materials and Feed Materials

5395 (CEA-1974) ETUDE DE LA PRECIPITATION DE SOLUTIONS PURES DE NITRATE D'URANYLE. (A Study of Precipitation from Pure Solutions of Uranyl Nitrate). J. Decrop, J. Holder, and J. Sauteron (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 36p.

Experimental work carried out in the laboratory and on a semi-industrial scale at the Le Bouchet plant on the precipitation of uranium from solutions of uranyl nitrate by ammonia (gaseous or in solution) and by ammonium carbonate is described. The purely chemical aspects (pH and composition of the precipitates) and the technical aspect of the various methods of precipitation (precipitation conditions, decanting, and filtering of the precipitates) are discussed. (auth)

5396 (CEA-1976) CONTRIBUTION A L'ETUDE DES FLUORURES INTERMEDIAIRES D'URANIUM. (Contribution to the Study of the Intermediate Fluorides of Uranium). Hoang-Nghi Nguyen (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 95p.

Thesis submitted to Univ. of Lyon.

The reaction of gaseous uranium hexafluoride with solid uranium tetrafluoride was studied at 20 to 300°C. The intermediate fluorides resulting from this reaction were prepared and then identified by chemical analysis and Debye-Scherrer diagrams. Their magnetic susceptibility and action on various common solvents were determined. The kinetic study was carried out up to 45°C at a constant gas pressure equal to 17.7 mm of mercury. The experimental results indicate that the reaction, limited by the diffusion process of ionic reactants, obeys the kinetic low: $L(1-C) = k\sqrt{t}$. The observed rate constant K and the diffusion coefficient D vary with the temperature according to the expressions: $K\ \text{min}^{-1/2} = -(1.88 \pm 0.22)\ 10^{8} \exp\{-[(14\,100 \pm 1\,400)\ \text{cal/mole/RT}]\}$ and $D\ \text{cm}^2\ \text{sec}^{-1} = (1.15 \pm 0.51)\ 10^{6} \exp\{-[(30\,200 \pm 5\,700)\ \text{cal/mole/RT}]\}$. (auth)

5397 (WAPD-T-1294) THE NATURE OF NONSTOICHIOMETRY IN URANIA-BASE SOLID SOLUTIONS. S. Aronson and J. Belle (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 1961. Contract AT(11-1)-Gen-14. 24p.

Presented at American Ceramic Society Meeting, Toronto, Canada, April 24, 1961.

Measurements of the electrical conductivity and thermoelectric power of nonstoichiometric uranium dioxide confirm the ionic description of nonstoichiometry in urania-base fluorite structures suggested on the basis of thermodynamic measurements and lattice energy calculations. Nonstoichiometric urania-base solid solutions appear to be relatively simple ionic solids containing U^{5+} ions and interstitial O^{2-} ions. The U^{4+}, U^{5+} and substitutional cations (Th^{4+}, Zr^{4+}, Y^{3+}) may be considered to be randomly distributed in the cationic lattice. The specific electrical conductance, σ_0, of nonstoichiometric uranium dioxide is adequately described by the equation $\sigma_0 = (3.8 \times 10^6/T) \exp(-0.30 + 0.03/kT)[U^{5+}][U^{4+}]$ where $[U^{5+}]$ and $[U^{4+}]$ are the concentrations of U^{5+} and U^{4+} ions, respectively. The thermoelectric power, Q, for nonstoichiometric uranium dioxide is approximately represented by the equation $Q = (k/e) \ln [U^{4+}]/[U^{5+}]$ where k is Boltzmann's constant and e is the electronic charge. Both equations are consistent with a simple ionic description in which activated electronic transfer occurs between U^{4+} and U^{5+} ions in the lattice. Other properties of uranium dioxide which were measured, such as magnetic susceptibility and oxygen diffusion, are briefly discussed in the light of the ionic model for UO_2. (auth)

5398 (JPRS-11423) INVESTIGATION OF THE POSSIBILITY OF RECOVERING OTHER VALUABLE METALS OCCURRING TOGETHER WITH URANIUM ORES. Karol Pinkas. Translated from Nukleonika, 6: 127-33(1961). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 3082.

5399 URANIUM AND THORIUM—THEIR PRODUCTION AND USE. Nuclear Energy. 506-9(Dec. 1961).

An account is given of various methods used throughout the world for refining thorium and uranium ore and producing thorium and uranium metal. (N.W.R.)

5400 TEKHNOLOGIYA URANA. (Technology of Uranium). V. B. Shevchenko and B. N. Sudarikov. Moscow, Gos Atomizdat, 1961. 330p.

The book is based on a series of lectures presented in 1958–1960 at the Moscow Order of Lenin Inst. of Chemistry and Technology. The chemical and physico-chemical properties of uranium compounds and ores are given. Processes for converting uranium ores into metal and alloys used as nuclear fuel are described, with special stress on the technological bases of the processes. The book is designed for graduate students and engineering-technical personnel. 92 references are included. (R.V.J.)

5401 PRODUCTION OF URANIUM. Australian Patent 221,854. Oct. 22, 1957.

An improved process is given for the magnesium reduction of UF_4 to produce uranium metal. In the past, there have been undesirable premature reactions between the Mg and the bomb liner or the UF_4 before the actual ignition of the bomb reaction. Since these premature reactions impair the yield of uranium metal, they can be inhibited by forming a protective film upon the particles of Mg by reacting it with hydrated uranium tetrafluoride, sodium bifluoride, uranyl fluoride, or uranium trioxide. This may be accomplished by adding about 0.5 to 2 per cent of the additive to the bomb charge.

5402 PREPARATION OF HIGH PURITY UF_4. Australian Patent 229,411. June 26, 1958.

A process is given for preparing highly pure uranous tetrafluoride from an impure uranium laden solvent extraction process strip solution which is at least 8 M in mineral acid. The process comprises treating said strip solution with a reducing agent thereby reducing the uranium in said strip solution to the +4 oxidation state, contacting the strip solution with an extractant phase comprising about 10 to 70% of tributyl phosphate in an organic solvent-diluent selected from the group consisting of benzene, ethyl-benzene, chlorobenzene, toluene, xylene, kerosene, and carbon tetrachloride to extract the uranium therein, treating the extract phase with an aqueous fluoride solution to precipitate uranous tetrafluoride therefrom, and separating the uranous tetrafluoride from the phases.

5403 DIRECT INGOT PROCESS FOR PRODUCING URANIUM. Australian Patent 229,523. June 26, 1958.

A process is described in which uranium tetrafluoride is reduced to the metal with magnesium and in the same step the uranium metal formed is cast into an ingot. For this purpose, a mold is arranged under and connected with the reaction bomb, and both are filled with the reaction mixture. The entire mixture is first heated to just below reaction temperature, and thereafter heating is restricted to the mixture in the mold. The reaction starts in the mold whereby heat is released which brings the rest of the mixture to reaction temperature. Pure uranium metal settles in the mold while the magnesium fluoride slag floats on top of it. After cooling, the uranium is separated from the slag by mechanical means.

5404 PRODUCTION OF HIGH PURITY URANIUM TETRAFLUORIDE. Australian Patent 232,233. Apr. 17, 1959.

A process is given for recovering uranium values from a material. The process comprises producing a solution of said material in above 8 M mineral acid, treating said acid solution with a reducing agent to place the uranium in the +4 oxidation state, contacting the reduced solution with an alkyl amine organic solvent-diluent extractant phase to extract the uranium therein, contacting the extract phase with a water phase to extract the uranium therein, and treating the water extract with an aqueous fluoride solution to precipitate a uranous fluoride salt therefrom.

Separation Processes

5405 (MCW-1456) THE EFFECT OF SULFATE ON THE EXTRACTION OF URANIUM BY DILUTED TRIBUTYL PHOSPHATE. Topical Report. G. P. Lang and M. O. Nethaway (Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.). Dec. 22, 1961. Contract W-14-108-Eng-8. 17p.

The effects of sulfate and nitrate ions on the extraction of uranium into TBP-hexane were studied. Concentrations of uranium in the starting solutions ranged from 0.15 to 480 g/l. Sulfate ions decrease the distribution coefficient for uranium, but the magnitude of the effect depended on the concentration of uranyl nitrate and of total nitrate ions in the aqueous phase. The higher the concentration of uranyl nitrate, the smaller the effect of sulfate in preventing extraction. (auth)

5406 (PAN-262/V) SEPARATION OF CALCIUM FROM SCANDIUM BY REVERSED-PHASE PARTITION CHROMATOGRAPHY. S. Siekierski and R. J. Sochacka (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). July 1961. 9p.

Reversed-phase partition chromatography was applied to the separation of carrier-free calcium from macroamounts of scandium. At the stationary phase TBP was used and elution was carried out with 6 to 10 $\underline{M}$ HCl. The influence of the amount of scandium introduced into the column on the position of the maximum and on the shape of the elution curves was investigated. The separation time is about 90 minutes. The best conditions for the separation of both elements were established. (auth)

5407 (TID-14329) PROGRESS REPORT ON [ELECTROCHEMICAL RESEARCH IN AMINE SOLVENTS]. Laura C. Trout and Frederic C. Schmidt (Indiana. Univ., Bloomington). [1961]. 28p. Contract [AT(11-1)-256].

Research is being carried out to determine cation transference numbers in ethylenediamine and ethanolamine using the Hittorf method. A method of obtaining radio-polarograms using radioisotopes of the reducible species as tracers was developed. Ion pair association constants of sodium salts in ethylenediamine were determined using a Na-amalgam indicator electrode. The density of trimethylenediamine was determined at 25.000 ± 0.001°C. The molar heats of solution of several electrolytes found to be soluble in anhydrous ethylenediamine are given in tabular form. The salts measured were NaI, $TlNO_3$, RbI, CuCN, $Pb(NO_3)_2$ CdI_2, $NaNO_3$, and HgI_2. An evaluation was made of techniques and apparatus for derivative polarography. (M.C.G.)

5408 (AEC-tr-4880) DECONTAMINATION FACTOR IN PROCESSING OF IRRADIATED URANIUM OXIDE BY VOLATILIZATION. J. Schmets and R. Heremans (Brussels. Centre d'Etude de l'Energie Nucleaire). Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.) from report BLG-58. Sept. 1, 1961. 30p.

The decontamination factor obtained during fluorination of irradiated UO_2 was studied. Purity criteria were established. The main impurity in the final product is I. NaF was used to eliminate some fission products. No complex formation between the fission product fluorides and the NaF was observed with certainty; however, this latter compound acts as an efficient filtering agent. The results of these laboratory scale experiments are commented on in view of practical applications. (auth)

5409 (JPRS-11184) PRODUCTION OF A SYNTHETIC INORGANIC CATION EXCHANGER AND ITS APPLICATION FOR SELECTIVE PLUTONIUM ISOLATION. D. Naumann. Translated from Z. Chem., 1: No. 8, 247-8(1961).

Preparation of a cation exchanger composed of Zr and Si oxyhydrates is described. The exchanger is stabilized with phosphate and has good capacity, high acid resistance, and satisfactory reproducibility of exchange properties. Data obtained in experiments using the exchange material for separation of Pu from U and from U–Ce systems are included. (J.R.D.)

5410 TREATMENT OF URANIUM LEACH PLANT SOLUTIONS BY LIQUID-LIQUID EXTRACTION TO PRODUCE HIGH PURITY URANIUM PRODUCTS. R. Simard, A. J. Gilmore, V. M. McNamara, H. W. Parsons, and H. W. Smith (Dept. of Mines and Technical Surveys, Ottawa). Can. J. Chem. Eng., 39: 229-34(Dec. 1961).

Three liquid-liquid extraction processes were tested in continuous equipment, on bench scale, to determine their relative merits in the purification of uranium as found in ion exchange eluates of various Canadian leach plants. Tri-n-butyl phosphate and dibutyl butylphosphonate were used as extractants on nitrate eluates. A tertiary amine was used in the case of sulfuric acid eluates. Optimum conditions for high recovery and low reagent costs were established, and the adaptability of the processes to existing leach plants is discussed. The suitability of the ammonium diuranate product as a source of ceramic-grade UO_2 was also investigated. Suggested changes to the adopted flowsheets are given, for further testing on a pilot plant scale. (auth)

5411 EXTRACTION STUDIES OF Zr AND Hf COMPLEXING WITH n-BROMOAMYGDALIC. I. P. Alimarin and Han-hsi Chên (Moscow State Univ.). Zhur. Neorg. Khim., 6: 2062-8(Sept. 1961). (In Russian)

Complexing Zr and Hf with n-bromoamygdalic acid and solvent separation by isoamyl alcohol was studied. The dissociation constant of n-bromoamygdalic acid at ionic strength $\mu = 1.0$ and the distribution coefficients at various ionic strengths in isoamyl alcohol–water and n-butanol–water systems were determined. (R.V.J.)

5412 COMPLEXING Hf WITH ACETYLACETONE IN SOLVENT EXTRACTION METHOD. V. M. Peshkova and Ang Pêng. Zhur. Neorg. Khim., 6: 2082-5(Sept. 1961). (In Russian)

Hf complexing with acetylacetone at 25° ± 0.1 and ionic strength 1.0 mole was studied, and acetylacetone dissociation and distribution constants were determined. The distribution constant of noncharged hafnium complex with acetylacetone in the system $C_6H_6-H_2O$ is $\lambda_4 = 10.30 + 0.10$. (R.V.J.)

5413 RECOVERY OF URANIUM FROM ORES THEREOF. Australian Patent 208,419. May 11, 1955.

A process for recovering uranium from an ore thereof is given which comprises leaching said ore with a mineral acid to provide a wet ore pulp, contacting said wet ore pulp with coarse pieces of an anion exchange resin to adsorb the uranium from said pulp, and then separating said coarse pieces from said wet ore pulp.

5414 RECOVERY OF URANIUM VALUES FROM URANIUM BEARING RAW MATERIALS. Australian Patent 209,884. June 24, 1955.

A process is given for the recovery of uranium from uranium containing ores, concentrates, or residues. Generally, the process comprises treating a finely divided uranium-bearing raw material with a mixture of sulfuric acid and manganese dioxide to oxidize the uranium in the material to the hexavalent state and to leach the resulting hexavalent uranium. Manganese dioxide is superior to ferric sulfate which is usually used in the sulfuric acid leaching solution. The uranium is recovered as the oxide by neutralization of the leach liquor which has been separated from the insoluble material. In the case of ores having a high phosphate content, ferric iron should be added to the leaching solution to complex the phosphate and thus prevent it from precipitating with the uranium.

5415 METHOD OF RECOVERY OF URANIUM BY A RESIN-IN-PULP PROCESS. Australian Patent 209,928. July 19, 1955.

A method is given for recovering dissolved uranium compounds from acid leach liquors. The method comprises contacting the liquor with ion exchange material capable of fixing uranium compounds in the form of complex ions in one zone, causing flow through a screen having a predominantly vertical component and openings at least two mesh sizes finer than the particle size of ion exchange material and at least 2 mesh sizes larger than the ore pulp particles, and causing a turbulent layer of gas and liquid bubbles to pass across the screen sufficient to prevent blinding of the screen whereby uninterrupted screening and circulation within the zone is effected. A group of such zones or cells are arranged in series, and as the ore pulp passes from cell to cell, its uranium content is completely extracted.

5416 VOLATILE CHLORIDE PROCESS FOR THE RECOVERY OF METAL VALUES. Australian Patent 217,241. May 10, 1957.

A process is outlined for recovering uranium, iron, and aluminum from certain shale type ores which contain uranium in minute quantities. The ore is heated with a chlorinating agent, such as chlorine, to form a volatilized stream of metal chlorides. The chloride stream is then passed through granular alumina which preferentially absorbs the volatile uranium chloride and from which the uranium may later be recovered. The remaining volatilized chlorides, chiefly those of iron and aluminum, are further treated to recover chlorine gas for recycle, and to recover ferric oxide and aluminum oxide as valuable by-products.

5417 URANIUM RECOVERY FROM ORES WITH HYDROCHLORIC. Australian Patent 217,288. Dec. 19, 1956.

A process is given for recovering uranium values from ores by solvent extraction. This is accomplished by disintegrating the ore and contacting it with an aqueous medium containing free hydrochloric acid so that a slurry is obtained and any lime is converted to calcium chloride. The acidulated ore slurry is partially dried and is then contacted with acetone for extraction. During this leaching step an extremely fast and complete settling of the ore is obtained if the ore particles are in a state of agglomeration caused by the presence of calcium chloride. For these reasons, the ore should contain some lime or limestone which will react with hydrochloric acid to form the necessary amount of calcium chloride.

5418 URANIUM RECOVERY FROM ALLOYS. Australian Patent 218,998. Aug. 21, 1957.

A process is given for dissolving uranium–zirconium alloys. The process comprises immersing said alloys in a molten zirconium tetrafluoride–sodium fluoride mixture, sparging the molten mixture with a fluorinating agent, such as bromine pentafluoride, bromine trifluoride, chlorine trifluoride, or fluorine, whereby zirconium fluoride and uranium hexafluoride are formed and the latter is volatilized while the zirconium fluoride formed remains in the zirconium fluoride–sodium fluoride melt.

5419 URANIUM RECOVERY PROCESS. Australian Patent 222,631. Jan. 17, 1958.

In the prior art of processing of uranium ores, the ore is first digested with nitric acid and filtered, and the uranium values are then extracted from the filtrate by contacting with an organic solvent. The insoluble residue has been processed separately in order to recover any uranium which it might contain. The improvement of this invention consists in contacting a slurry, composed of both solution and residue, with the organic solvent prior to filtration. The result is that uranium values contained in the residue are extracted along with the uranium values contained in the solution in one step.

5420 RECOVERY OF URANIUM FROM LOW GRADE URANIUM BEARING ORES. Australian Patent 222,838. May 8, 1957.

A method is given for recovering uranium from low-grade geologic deposits. The method consists in chlorinating the inorganic portions of the ore at a temperature sufficient to form a volatile chloride stream containing the desired uranium. The volatilized chloride stream is then contacted with a molten alkali chloride to selectively retain uranium values in the molten alkali chloride phase. The uranium may be separated from the alkali metal chloride by known solvent extraction techniques.

5421 CATALYZED OXIDATION OF URANIUM IN CARBONATE SOLUTIONS. Australian Patent 223,299. Feb. 18, 1958.

A process is given for the dissolution of a material containing uranium in hexavalent and lower valent oxidation states to produce a carbonate solution thereof. The process comprises contacting said material with a carbonate leach solution containing catalytic amounts of the ionic species of metals selected from the group consisting of Co, V, Ti, Mn, and Cu at a temperature of above about 80°C, and simultaneously providing an oxidizing agent selected from the group consisting of air, O_2, and hypochlorite in such solution to oxidize and dissolve the uranium in said material.

5422 PROCESS OF RECOVERING URANIUM FROM ITS ORES. Australian Patent 223,777. Oct. 30, 1957.

The crushed ore is mixed with 5 to 10% of sulfuric acid and added water to about 5 to 30% of the weight of the ore. This pugged material is cured for 2 to 3 hours at 100 to 110°C and then cooled. The cooled mass is nitrate-conditioned by mixing with a solution equivalent to 35 pounds of ammonium nitrate and 300 pounds of water per ton of ore. The resulting pulp containing 70% or more solids is treated by upflow percolation with a 5% solution of tributyl phosphate in kerosene at a rate equivalent to a residence time of about one hour to extract the solubilized uranium. The uranium is recovered from the pregnant organic liquid by countercurrent washing with water. The organic extractant may be recycled. The uranium is removed from the water solution by treating with ammonia to precipitate ammonium diuranate. The filtrate from the last step may be recycled for the nitrate-conditioning treatment.

5423 ORGANIC ORTHOPHOSPHATE EXTRACTANTS AND PROCESS. Australian Patent 223,914. June 20, 1957.

Methods are given for the preparation of mono- and dialkyl esters of ortho-phosphoric acid derived by reaction of P_2O_5 with alcohols such as 2,6-dimethyl heptanol-4, 2,6,8-trimethyl nonanol-4, 2-methyl-7-ethyl decanol-4, 2-methyl-7-ethyl indecanol-4 and 3,9-diethyl-tridecanol-6, in the presence of a hydrocarbon solvent. These esters may be used to extract uranium and vanadium values from ores thereof after said ores have been suitably treated with a mineral acid, such as sulfuric acid.

5424 PROCESS FOR SEPARATION OF PROTACTINIUM, THORIUM AND URANIUM FROM NEUTRON-IRRADIATED THORIUM. Australian Patent 225,934. July 31, 1957.

The process comprises contacting an aqueous nitric acid solution of neutron-irradiated thorium, under net nitrate ion desufficient conditions, with a solution of a trialkyl phosphate in an inherent organic diluant, thereby extracting uranium and thorium into resulting organic phase while confining protactinium and fission products to the resulting aqueous phase, scrubbing any small amounts of protactinium and fission products from said organic phase with aqueous solution of an inorganic nitrate salt, separating the protactinium-containing aqueous phase from uranium and thorium-containing organic phase, and thereafter separating thorium and uranium from the separated organic phase.

5425 PRODUCTION OF PURIFIED URANIUM. Australian Patent 226,144. Apr. 23, 1958.

A pyrometallurgical method is given for processing nuclear reactor fuel elements containing uranium and fission products and for reducing uranium compounds to metallic uranium. If the material processed is essentially metallic uranium, it is dissolved in zinc, the solution is cooled to crystallize UZn_9 therefrom and the UZn_9 is distilled to obtain uranium. For uranium compounds, the solvent is an alloy of zinc and magnesium and the remaining steps are the same.

5426 REGENERATION OF REACTOR FUEL ELEMENTS. Australian Patent 231,836. June 11, 1959.

A process is given for concentrating by electrolysis the uranium and/or plutonium of an aluminum alloy containing these actinides, after the actinide has been partially consumed by neutron bombardment in a reactor. The alloy is made the anode in a system having an aluminum cathode and cryolite electrolyte. Electrolysis from 22 to 26 ampere-hours removes a sufficient quantity of aluminum from the alloy to make it suitable for reuse.

5427 PROCESS FOR THE RECOVERY OF ZIRCONIUM VALUES. Charles Jacob Sindlinger and Carl Cleveland Clayton, Jr. (to Columbia-Southern Chemical Corp.). British Patent 885,060. Dec. 20, 1961.

A process is outlined for recovering zirconium from zircons and other zirconium silicate ores. In the process, alkali metal hydroxide is added to the ore and the mixture is heated to initiate reaction, the reaction being conducted in the presence of alkali metal zirconate and under conditions such that the mixture does not melt. The proportion of the zirconate used should be 1 to 5 parts by weight per part by weight of the ore. The resulting frit is then treated with water to extract the SiO_2 and with acid to extract the zirconium. (D.L.C.)

5428 PROCESS FOR THE RECOVERY OF ZIRCONIUM VALUES. Charles Jacob Sindlinger and Carl Cleveland Clayton, Jr. (to Columbia-Southern Chemical Corp.). British Patent 885,061. Dec. 20, 1961.

A process for recovering zirconium from zirconium silicate ores is outlined which is based on the breaking of the ZrO_2-SiO_2 bond by reaction with an alkali metal hydroxide. In this process, pulverized zirconium ore is heated and an akali metal hydroxide is added to the heated ore under such conditions that the reaction mixture does not become fluid. The hydroxide may be pulverized solid, molten, or in aqueous form. The advantages of the process are that the reaction is more complete and corrosion of the container by the hydroxide is minimized. The frit product may then be treated with water to extract the SiO_2 and with acid to extract the zirconium. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

5429 (APDA-144) CONCEPTUAL DESIGN OF AN IN-PILE PACKAGE LOOP FOR FAST REACTOR FUEL TESTING. (Atomic Power Development Associates, Inc., Detroit). July 28, 1961. Contract AT(11-1)-865. 197p.

The results of a conceptual design study performed to adapt an in-pile package loop (PW-19) for use as a fast reactor fuel test facility in the Advanced Test Reactor are given. Two design modifications were made to the lower end of the existing loop: lengthening the test specimen section and installing a removable closure. Two concepts for removing the heat generated by the test fuel bundle were developed. A boron-loaded thermal neutron filter surrounding the loop provided the test fuel with a neutron spectrum approximating that of a fast reactor. (M.C.G.)

5430 (DC-57-3-131) SINGLE PHASE SATURABLE REACTOR CURRENT REFERENCE. Phillip C. Sharr (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 20, 1957. Contract AT(11-1)-171. 13p.

Design and performance of a single-phase Zener-regulated, saturable reactor, laboratory model, current reference are examined. (J.R.D.)

5431 (EURAEC-160) STUDY ON VIBRATIONS AND PRESSURE LOSSES IN NESTS OF TUBES. Preliminary Theoretical Study. Special Report No. 1. P. Leon (Societe Grenobloise d'Etude et d'Applications Hydrauliques, Grenoble, France). [1961]. Work performed under United States-Euratom Joint Research and Development Program. Contract 025.60.10RDF. 160p. (Includes original in French, 86p.).

A preliminary theoretical study was made of vibration induced in nests of tubes by excitations of hydrodynamic origin in order to collect and analyze studies already carried out on a similar subject. Two main types of nests were envisaged: one corresponding to standard heat exchangers, the other to fuel assemblies of nuclear reactors. Topics covered include phenomena observed on the downstream side of a generated cylinder immersed in a flow, vibrations of cylinders immersed in a flow, phenomena of the downstream side of two cylinders, oscillations in the case of several parallel cylinders, and oscillations in the case of a nest of parallel tubes. (M.C.G.)

5432 (GAMD-1931) DRYING OF GLOVE BOX ATMOSPHERES. G. B. Engle (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Dec. 15, 1960. Contract AT(04-3)-314. 5p.

The results of work to obtain and maintain dry argon atmospheres are presented. Procedures for operating dry boxes equipped with the drying system are outlined. The system of a silica gel tower followed by a commercial electro-dryer was chosen for use with the glove boxes. Although BaO and P_2O_5 had better drying powers, they were less attractive for long term drying operations. (M.C.G.)

5433 (NP-11145) ION PRODUCTION STUDIES WITH A MODIFIED VON ARDENNE DUO PLASMATRON ION SOURCE (thesis). Werner K. Kern (Florida State Univ., Tallahassee). June 1961. 48p.

An ion source of the von Ardenne duoplasmatron type was assembled and tested. Optimum operating parameters were established and components calibrated using H. O was introduced to evaluate the capability for production of heavy ions. The usable extraction voltage is limited, but with small modifications in the electrode assembly the limitation can be overcome. (J.R.D.)

5434 (NP-11192) HOT GAS SERVOMECHANISM THEORY AND TECHNOLOGY: AN ANNOTATED BIBLIOGRAPHY. Eugene E. Graziano, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Oct. 1961. Contract NOrd 17017. 25p. (SB-61-57)

A selected list of 60 annotated references on hot gas servomechanisms including design, analysis, components, and experience is presented. Selected items in related areas, such as pneumatics, are included. (auth)

5435 (ORNL-TM-75) A LABORATORY GAS-CIRCULATING PUMP. B. McNabb, Jr., and H. E. McCoy, Jr. (Oak Ridge National Lab., Tenn.). Nov. 30, 1961. Contract [W-7405-Eng-26]. 14p.

A pump was developed for pumping carbon dioxide in a closed loop without introducing impurities. This pump will give flow rates of up to 3 liters/min and will develop a working pressure of over 70 mm Hg. No wear was observed after 2000 hr of testing. It is felt that this pump is more desirable for this application than those developed by other experimenters for two reasons: the relatively inexpensive construction of the pump and the associated electronic circuit and the low coefficient of friction between the piston and the cylinder wall. Various modifications are suggested which will make this pump satisfactory for other applications. (auth)

5436 (ORNL-TM-102) INSTANTANEOUS AND TIME-DEPENDENT COLLAPSE OF OFHC COPPER VESSELS BY EXTERNAL PRESSURE. C. R. Kennedy (Oak Ridge National Lab., Tenn.). Jan. 5, 1962. Contract [W-7405-eng-26]. 17p.

Mechanical properties of annealed OFHC copper were obtained from the literature and supplemented by testing at the Oak Ridge National Laboratory (ORNL). The data include short-time tensile properties, elastic constants, and creep strength values from room temperature to 800°F. Annealed OFHC copper exhibited a very low proportional limit; thus, the yield strength determined by the offset method was ambiguous and considerable scatter resulted. The remaining measured properties, however, were fairly consistent with small deviations resulting from differences in the final annealing treatment. A master curve for determining the critical pressures for collapse of cylindrical vessels is given and methods of obtaining the critical pressure for collapse of cylindrical vessels are demonstrated for both the instantaneous and time-dependent cases. These methods are applicable only for nearly perfect cylinders; thus, it is important either to maintain close dimensional control or use appropriate safety factors in determining the critical pressure for collapse. (auth)

5437 (PWAC-318) DEVELOPMENT TESTS OF THE TP-1 LIQUID METAL TURBOPUMP AND COMPONENTS. H. V. Marman, R. S. Lombard, P. G. Standley, C. W. Grennan, H. J. Sarrett, and J. P. Butler (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). June 30, 1961. Contract AF33(600)-40548. 216p.

The development status of a 3000-gpm liquid metal turbopump, designated TP-1, is described. Development tests in liquid metal, performance tests in water, mechanical center section tests in liquid metal, turbine performance tests, impeller performance tests in water, dynamic seal performance tests in water, face seal evaluation tests, and impeller and scroll matching tests in air are discussed. (M.C.G.)

5438 (TID-12561) AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE STABILITY OF EXTERNALLY-PRESSURIZED, GAS-LUBRICATED THRUST BEARINGS. Interim Report. L. Licht and H. G. Elrod, Jr. (Franklin Inst. Labs. for Research and Development, Philadelphia). Feb. 1961. Contracts [AT(30-1)-2585] and Nonr-2342(00). 223p. (I-A2049-12)

An investigation was made of the stability of externally-pressurized, gas-lubricated bearings. An analysis was made which treated the flow within the gas film on a distributed, rather than on a lumped parameter basis. Rectangular and circular bearing configurations were considered and the effect of several parameters on stability was investigated. Results of this analysis were compared and contrasted with those obtained from earlier, simplified theories. The experimental program pursued was guided by the analysis. An apparatus was designed, constructed, and instrumented to provide for the variation of governing parameters and for the accurate determination of their critical values. Comparison of theory and experiment was made. The validity of theoretical assumptions, relative to the experimental model, is discussed. (auth)

5439 (CEA-tr-R-1389) POMPES ELECTROMAGNETIQUES POUR LES METAUX LIQUIDES. (Electromagnetic Pumps for Liquid Metals). A. I. Vold'ek. Translated into French from Elektrichestvo, No. 5, 22-7(1960). 22p.

There are two types of electromagnetic pumps—conduction pumps and induction pumps—and each type possesses in turn a variety of pumps. Direct-current and alternating-current pumps and linear induction plate pumps are briefly described, and the theory of these pumps is indicated. (J.S.R.)

5440 AN INCINERATOR FOR WASTES CONTAINING MICROCURIE AMOUNTS OF CARBON-14. Victor E. Lavetter (Bureau of Industrial Hygiene, Detroit). Am. Ind. Hyg. Assoc. J., 22: 485-8(Dec. 1961).

A description is given of a small rotating drum incinerator designed for the quantitative ignition of a radionuclide whose combustion product is gaseous at normal temperature and pressure. Samples of the flue gases and mineral residues indicated that the system was safe for disposal of small animals containing microcurie amounts of radiocarbon. Flue gases from the special incinerator mix with those from a large municipal incinerator, and discharge through a chimney 150 feet high after the mixture passes through a wet fly ash collector. (auth)

5441 THE ACHIEVEMENT OF VERY HIGH PUMPING SPEEDS IN THE ULTRA-HIGH VACUUM REGION. D. R. Sweetman (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 13: 317-20(Oct. 1961). (In English)

The gettering action for hydrogen of a freshly evaporated film of titanium was investigated at surface temperatures between 25 and −196°C. At 25°C, sticking probabilities of 13% are observed. At −196°C, the sticking probability is greatly increased and is estimated to be greater than 50%. It remains high until a mono layer has formed on the surface. (auth)

5442 AN AUTOMATIC SAMPLE CHANGER. G. J. Sprokel (International Business Machines Corp., Endicott, N. Y.). Nuclear Instr. & Methods, 13: 330-4(Oct. 1961). (In English)

The instrument described permits automatic assay of up to 40 radioactive samples. It may be programmed to record the number of the samples being assayed, the accumulated radiation count, and the elapsed time. Complete design data and circuit diagrams are included. (auth)

5443 ELECTROSTATIC QUADRUPOLE LENSES. A. Septier and J. Van Acker (Faculté des Sciences, Paris and Laboratoire d'Electronique, Fontenay aux Roses, France). Nuclear Instr. & Methods, 13: 335-55(Oct. 1961). (In French)

The expression for the potential $\phi(x,y,z)$ within the useful zone of a quadrupole lens was established not only for the excitation potentials symmetrical with respect to the earth, but also when these potentials are asymmetrical. New terms arise as a result of this asymmetry, which have a pronounced effect upon both the sense and the size of the aperture aberration. First order optical properties and results of an experimental study, the object of which is to determine the equivalent length of the lenses and to establish the quantitative behavior of a doublet, are recapitulated. The results of research devoted to measuring and correcting the aperture aberration are given, and methods which are equally valid in stigmatic and in astigmatic operation are suggested for correcting this aberration. The "third-order" equations of motion have been established for excitations of both kinds and with the aid of these equations the spherical aberration in any system of electrostatic quadrupole lenses can be calculated. This calculation was performed numerically for a doublet, and the values obtained agree well with the experimental results. (auth)

5444 INEXPENSIVE TARGET CHAMBER WITH PORT MOVABLE THROUGH ZERO DEGREES UNDER VACUUM. J. R. Erskine and C. P. Browne (Univ. of Notre Dame, Ind.). Nuclear Instr. & Methods, 13: 359-60(Oct. 1961). (In English)

A simple and inexpensive target chamber with an exit port that can be moved under vacuum through angles from −5 to 140° is described. The movable seal is made by a spring steel tape sliding against a rubber gasket. A method of moving this tape is presented. The chamber was built for use with a broad-range spectrograph but would be suitable for use with other detecting devices. (auth)

5445 PORTABLE X-RAY OR GAMMA SOURCE. Australian Patent 200,969. Jan. 27, 1955.

A source of radioactivity is described which is compact and portable. The assembly comprises a body of shielding material having a curved passage extending therethrough, a capsule containing radioactive material and being slidably mounted in the passage for movement between an active position adjacent a wide end passage opening and an inactive position midway between the passage ends, and a wire rod attached to the capsule in cooperation with a spring to enable an operator to move the capsule into the active position and automatically return the capsule to the inactive position when radiation is not desired.

5446 IMPROVEMENTS IN OR RELATING TO THERMOCOUPLES. Hermann Richard Lorch (to British Insulated Callender's Cables Ltd.). British Patent 884,281. Dec. 13, 1961.

An improved cable possessing high flexibility and high tensile strength is designed for use as a thermocouple and is particularly useful for measuring temperatures in reactors. The cable comprises one or more cores consisting of a mineral-insulated thermocouple cable associated with cores of higher tensile strength than the thermocouple cable. (D.L.C.)

5447 IMPROVEMENTS RELATING TO FINNED TUBES. George Thomas Maughan and Thomas Edwin Chapman (to Fairey Co. Ltd.). British Patent 884,981. Dec. 20, 1961.

A finned tube is designed for use as reactor fuel cans and for other heat exchange purposes. The tube is provided with two fin patterns, one formed integrally with the tube and the other formed separately on the tube and intersecting the first pattern at an angle. (D.L.C.)

5448 IMPROVEMENTS IN OR RELATING TO PIPING SYSTEMS. (to Commissariat à l'Énergie Atomique). British Patent 885,549. Dec. 28, 1961.

A piping system is described which is particularly well suited for the transportation of liquefied gases at very low temperatures. The system comprises a number of pipe lengths surrounded by a sleeve in which liquid N_2 is circulated, the connections between lengths being made within prismatic boxes and bent into bows. This type of connection has a number of advantages over the usual bellows type of connections. (D.L.C.)

5449 IMPROVEMENTS IN OR RELATING TO FLUID OPERATED PICK-UP MECHANISMS. Frederick William Friars and Herbert Chilvers Knights (to United Kingdom Atomic Energy Authority). British Patent 885,707. Dec. 28, 1961.

A pick-up mechanism of the type described in British Patent 808,736 for the manipulation of irradiated fuel elements submerged in a deep pond is improved. The improvements consist of supporting the outer tube of the telescopic pair of tubes pivotally in a movable carrier instead of by a float, and providing a longitudinal keying to prevent relative rotary movement between the tubes while permitting axial movement. (D.L.C.)

5450 IMPROVEMENTS RELATING TO SHOCK ABSORBERS. John George Morland (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 885,781. Dec. 28, 1961.

A shock absorber is designed for absorbing longitudinal impact shocks in reactor control rods being dropped within a reactor. The shock absorber comprises a buffer member with one end projecting from the control rod and the other end being tapered and projecting into a deformable sleeve attached to the rod. When an impact shock is received by the rod, the retaining members holding the buffer to the rod are broken and the tapered end of the buffer is driven into the sleeve to dissipate the impact energy. (D.L.C.)

5451 REMOTE CONTROL DEVICE FOR MACHINERY AND COUPLINGS. (to Geartight Unions Ltd.). French Patent 1,211,483. Mar. 16, 1960.

Remote control devices are described enabling the coupling of two elements, each element being provided with a threaded portion so that the coupling can be effected by screwing together these elements. This remote control device comprises a movable support in which a toothed wheel is mounted on a driving axle, positioned parallel to the axis of the element, and may slide along this axle. The axial position of this toothed wheel on the axle is controlled by the action of pneumatic cylinder-piston means, while the said support as a unit may be displaced in a direction perpendicular to the axis of the element by other cylinder-piston means in order to couple the toothed wheel with a toothed ring fixed on one of the said elements, the driving toothed wheel following the axial displacement of this element during its screwing movement. (NPO)

5452 STOP VALVE CONTROLLED BY A PISTON IN PARTICULAR FOR HIGH PRESSURE CIRCUITS. (to Th. Jansen G.m.b.H.). French Patent 1,226,818. Aug. 16, 1960.

A stop valve comprises a nearly cylindrical valve casing with connection collars on the two extremities. The upstream side of the casing is provided inside with two successive seatings against each of which an annular gasket can be pressed by a disc-shaped valve body that is axially displaceable. The gasket positioned on the upstream side has a greater diameter than the other gasket and is constituted by an elastic torus; the annular space formed in the closed position between the two valve seatings may be evacuated. The axial displacement of the valve body is effected by a piston that slides in a cylinder provided coaxially inside the valve casing and is connected with the valve body by an axial bar. The downstream side of this cylinder is closed and may be put into communication with a pressure fluid for actuating the valve, while the upstream side is perforated, so that it communicates with the remaining hollow space in the valve casing. The said connecting bar is guided in a collar supported by several radial members connecting the collar with the valve casing. Preferably, some of these members are hollow and enclose means for holding the valve in the closed position or for position indication. (NPO)

5453 DEVICE FOR HANDLING MATERIALS. (to Babcock & Wilcox Ltd.). French Patent 1,228,812. Sept. 2, 1960.

In a nuclear reactor with vertical channels, the discharge is often effected from the top of the reactor, the fuel elements being taken away from the channels and loaded into a discharging machine movable on the charging floor situated above the reactor. During these operations the axis of the fuel element remains nearly vertical. As a rule, these elements are then charged from this discharging machine into a transport container. According to this patent, the fuel elements have their axes horizontal as they are placed in this container. To this end, a handling device is provided comprising a container able to accommodate the elements. The container is pivotally mounted and can occupy a vertical position when the fuel elements are to be received from above and a horizontal position when they are to be released and to fall down into the said transport container. Suitably, the container has articulated parts, so that the bottom is closed when the container is turned up to receive the fuel elements, and is opened by cam devices during the last stage of the movement of the container into a horizontal position. (NPO)

5454 LIFTING DEVICE FOR NUCLEAR ENGINEERING. (to Plessey Co., Ltd.). French Patent 1,233,492. Oct. 12, 1960.

A totally mechanical lifting device comprising a grab organ is described. This grab organ has a number of gripping elements situated at different places in its periphery, each having a forward position for engaging with the body to be lifted and a retracted position for releasing it. Means are provided for constraining these elements in the retracted or in the forward position. Preferably, the body to be lifted has a male cone-shaped handling head which during the let-down movement of the grab enters a tube mounted in the center of said grab, the tube having a funnel shaped lower extremity. The said gripping elements are suitably constituted by balls that rest in lateral openings of the tube and can be pushed in centripetal direction. These elements are held in the retracted position by a piston sliding in the tube, the piston being moved back against spring action by the handling head of the body as it enters the tube. On the said tube a further tube slides, the lower extremity of which has a female cone-shaped surface so that the axial thrust imposed on this outer tube is transformed into the centripetal thrust imposed on the balls when this surface abuts against them; in this way the balls are made to engage in an annular recess in the handling head. In the forward position of the balls, this latter tube slides over the openings in which the balls rest to lock the balls in the forward position. (NPO)

5455 IMPROVEMENTS RELATING TO TELEVISION CAMERAS. (to Pye Ltd.). French Patent 1,245,784. Oct. 3, 1960.

The television camera described enables the inspecting of the inside of a nuclear reactor during its operation and is resistant to the influences of radiation and heat developed in the reactor. The materials for the construction of this camera are chosen so that they have: (1) A sufficient resistance to the undesirable influences of the radiation in order to ensure a reasonable working life; (2) A low degree of induced radioactivity so that it is possible to repair defects after a reasonable lapse of time; (3) A low neutron absorption cross section in order to avoid undesirable influences on the reactor operation or to avoid too high a development of heat inside the camera. The portions of the camera subjected to the influence of radiation comprise only the lens, the camera tube, the means for deflecting and focusing the beam of electrons, and the preamplifier. Suitably, the camera is placed in a casing constituted by several coaxial annular chambers through which a gaseous coolant is passed. The wiring and the coils are made of aluminum, as is a part of the structural components. The cores of the coils are made of a ceramic, while the lens is made of a stabilized glass or of an artificial sapphire. (NPO)

Heat Transfer and Fluid Flow

5456 (AFOSR-1562) HEAT TRANSFER IN A COMPLETELY IONIZED GAS. Report No. 61-7. Brit-Marie Jepson (Massachusetts Inst. of Tech., Cambridge. Magnetogasdynamics Lab.). July 1961. Contract AF49(638)-643. 22p.

Heat transfer rates and temperature profiles were calculated for a completely ionized gas in laminar boundary layer flow over a flat plate. Using the assumptions of low Mach number, zero Prandtl number, and no pressure gradient, the solutions were obtained by numerical integration of the differential energy equation utilizing an iterative method of solution. The gas considered was treated as a homogeneous perfect gas under no electric or magnetic fields. The thermal conductivity of the gas was assumed to vary as the absolute temperature to the B power. Solutions were obtained for $B = 5/2$ (completely ionized gas) as well as for $B = 1$ and $\frac{1}{2}$ for comparison with other solutions. By an approximate method of solution a simple relationship for the heat transfer rate was found which depends only upon B and the ratio of wall temperature to free stream temperature. This approximate relationship was found to be within 2% of the numerical results. (auth)

5457 (AGN-8036) ENGINEERING INVESTIGATIONS OF CENTRIFUGAL CREEP TESTING MACHINE. Summary Report. (Aerojet-General Nucleonics, San Ramon, Calif.). July 1961. Contract AT(04-3)-368. 82p.

Development of a centrifugal creep testing machine is reported which proved to be compact, reliable, and adaptable for in-pile materials testing. A theory was developed for converting centrifugal creep data into conventional creep values for conditions of uniform outer fiber stress and strain. These conditions were achieved with specially tapered samples whose creep bonding profile is circular throughout the gage section. Centrifugal creep tests were conducted with tapered samples of 99.44% pure Al and with 99.80% pure Fe to confirm this theory. It is concluded that cantilever bending creep data from centrifugal tests are convertible into accurate conventional creep-tension values. (J.R.D.)

5458 (APEX-132) SINGLE STAGE HEAT TRANSFER AND PRESSURE DROP TESTS. Robert W. Carr, David J. Jay, Robert Boggild, and William Morgan (General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati). Dec. 1952. Decl. June 16, 1961. Contract [AT(11-1)-171]. 46p.

Features are described for an apparatus designed to make a rough determination of the heat-transfer coefficient near reactor air-flow design conditions for a geometry similar to, but not identical with, the R-1 reactor. The apparatus was also used to secure information on temperature distribution through the specimen as well as pressure-drop data. Operating techniques were perfected and design data for a multiple-element heat-transfer apparatus were obtained. (C.H.)

5459 (GA-2706) HEAT-WAVE TECHNIQUES FOR THE MEASUREMENT OF THERMAL DIFFUSIVITY. MARITIME GAS-COOLED REACTOR PROGRAM. M. Cutler and G. T. Cheney (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Dec. 1, 1961. Contract AT(04-3)-187. 38p.

A method for measuring thermal diffusivity is proposed; this method consists in suddenly heating one end of a sample and measuring the time it takes for a heat wave to arrive at the other end. A mathematical analysis of the method is presented for two kinds of boundary conditions relating to the heat input. These conditions correspond to stepfunction heating by radiation and by a good contact to a constant-temperature heat source, such as a liquid metal. In addition to consideration of the effects on the analytic solution due to radiation heat loss, other factors which affect the accuracy and sensitivity of the technique are discussed. The heat-wave method is generically related to many other techniques for measuring thermal diffusivity. The interrelationships between these different techniques are discussed. (auth)

5460 (HW-71668) THERMAL STRESSES IN HEAT EXCHANGERS AND PIPING. A COMPARISON OF CARBON AND STAINLESS STEEL. W. J. Love (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 14, 1961. Contract [AT(45-1)-1350]. 6p.

A discussion is given of methods for determining the thermal stresses incurred in piping and heat transfer equipment. A derivation is given of plate thermal stresses under a constant rate of change of surface temperature. (B.O.G.)

5461 (KAPL-M-EC-11) STABLE-2—HYDRAULIC FLOW STABILITY ANALYSIS. Donald G. Dight (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 15, 1961. Contract W-31-109-Eng-52. 47p.

STABLE-2 is a Philco 2000 digital computer program that examines the hydraulic stability of a single boiling coolant channel in parallel with many other channels. The open and closed loop response is obtained at specified frequencies, using transfer functions derived from the linearized equations of the system. The equations are basically those of continuity and conservation of energy and momentum. The program computes the coefficients of these linearized equations, as well as the coefficients required to perform the calculation on an analog computer. The approximate running time is 5 seconds per case. (auth)

5462 (KAPL-M-PF-9) REDUCTION OF HOT CHANNEL TEMPERATURE RISE DUE TO MIXING IN RECTANGULAR CHANNELS. J. P. Fraser (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 30, 1961. Contract W-31-109-Eng-52. 26p.

A description is given describing a method for calculating the reduction in bulk temperature rise distribution with considerations for the transverse turbulent diffusion. The method can be applied for arbitrary axial and radial power distributions, and is applicable for single phase flow but is conservative if extended into regions of subcooled boiling. Examples are given showing numerical results for typical power distributions. (B.O.G.)

5463 (TID-14439) BASIC EXPERIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report for November 1961. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Nov. 30, 1961. Contract AT(30-3)-187. 17p. (MPR-X-11-61)

A brief account is given of 3 future 19-rod test sections which are planned to extend the range of variables studied with the CU 19-rod test section. Preliminary experimental results are presented for forced convection boiling of water at 1000 psia in a bundle of 19 heated rods. Safe operating areas are mapped out, several instrumented burnout points are given, steady state heat transfer coefficients and wall temperatures are presented, and the intentional physical failure is described. (auth)

5464 (TID-14462) FREE CONVECTIVE HEAT TRANSFER TO A SUPERCRITICAL FLUID—AN ANALYTICAL AND EXPERIMENTAL STUDY. Technical Report No. 9. C. A. Fritsch and R. J. Grosh (Purdue Research Foundation, Lafayette, Ind.). Nov. 1961. Contract AT(11-1)-1026. 163p.

Thesis submitted to Purdue Univ.

Laminar free convection from an isothermal, vertical flat plate was studied for water close to its critical point where there are marked variations in density and specific heat. Similarity methods were applied to the laminar, two-dimensional boundary layer equations so that they could subsequently be integrated on a digital computer for various water states. Heretofore no solutions were available where the variations in density and specific heat were taken into account in accordance with the real fluid behavior in the supercritical region. Numerical results were obtained for pressures ranging from the critical pressure, 3208 psi, to 3400 psi and for temperature differences up to 20 degrees Fahrenheit at various bulk fluid temperatures. These results differed appreciably from those predicted by a constant property analysis. An experimental investigation was also undertaken for the region of the analytical study. All of the trends indicated in the analytical results were verified by the experimental data. There was a systematic deviation of about 20%, the analytical results being consistently lower than the experimental observations. However, this could easily be due to the lack of precise thermal conductivity and dynamic viscosity data for the region of interest. This investigation established that considerations of the basic conservation and state equations with variable properties adequately describe free convective heat transfer in a supercritical fluid. (auth)

5465 (USNRDL-TR-534) DYNAMIC FLAW DETECTION USING PENETRATING RADIATION AND SCINTILLATION DETECTION. K. F. Sinclair and G. W. Hitchcock (Naval Radiological Defense Lab., San Francisco). Oct. 10, 1961. 35p.

The design and performance of continuous scan type flaw detection systems are described for use in the detailed examination of solid propellant missile motors. The factors affecting performance are discussed individually and related in a system equation. An experimental system, using two scintillation detectors in a differential configuration, is described and tests performed using isotopic and x-ray sources are reviewed. The predicted performance and the experimental results obtained are compared. (auth)

5466 (XDC 55-11-117) FOUR GROUP HEAT TRANSFER SIMULATOR. B. Kaplan and A. F. Mentink (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 17, 1955. Decl. June 5, 1961. Contract AT (11-1)-171. 18p.

A variable air flow heat transfer simulator for HTRE is presented. The inputs are airflow, reactor power level, and reactor inlet air temperature. All outputs can be simultaneously recorded or inserted into other simulators for control studies. (J.R.D.)

5467 (CEA-tr-R-1410) DONNEES EXPERIMENTALES SUR LA CHALEUR SPECIFIQUE DE LA VAPEUR D'EAU SOUS DES PRESSIONS DE 300 A 500 ATMOSPHERES ABSOLUES ET A DES TEMPERATURES DE 500 A 600°C. (Experimental Data on the Specific Heat of Steam under Absolute Pressures of 300 to 500 Atmospheres and at Temperatures of 500 to 600°C). A. M. Sirota and B. K. Mal'tsev. Translated into French by B. de Trezvinsky from Teploenergetika, 7: No. 10, 67-8(1960). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 2012.

5468 MICROSCOPIC STUDY OF BUBBLE GROWTH DURING NUCLEATE BOILING. P. H. Strenge, Aluf Orell, and J. W. Westwater (Univ. of Illinois, Urbana). A.I.Ch.E. Journal, 7: 578-83(Dec. 1961).

A photographic technique was used to determine bubble growth rates for ether and pentane boiling on vertical metal surfaces of zinc and an aluminum alloy at atmospheric pressure at saturation conditions. Motion pictures were taken at about 3,000 frames/sec through a microscope which produced a 13× magnification on the film. The heat flux was varied from about 3,000 to 13,000 Btu/(hr)(sq. ft). In seven runs out of nine the late-growth equations of Forster and Zuber, Plesset and Zwich, and others were in error by less than 40% for bubble diameters from about 0.1 mm up to the full field of view of about 0.75 mm. For sizes below 0.1 mm the growth was too rapid to be measured. Interesting observations which are described quantitatively include vibrations, irregularities in nucleation, and statistical variations in growth rates. (auth)

5469 THE MEASUREMENT OF RAPID SURFACE TEMPERATURE FLUCTUATIONS DURING NUCLEATE BOILING OF WATER. Franklin D. Moore and Russell B. Mesler (Univ. of Kansas, Lawrence). A.I.Ch.E. Journal, 7: 620-4(Dec. 1961).

The surface temperature during nucleate boiling was measured with a special thermocouple so designed as to measure the temperature of a small area and to have an extremely rapid response time. The surface temperature was found to drop occasionally 20 to 30°F in about 2 msec during the boiling of water. This indicates a rapid extraction of heat during a short time interval. The significance of this observation is that it provides an important new clue to an understanding of nucleate boiling. A hypothesis is advanced to explain these observations. (auth)

5470 SHEAR FLOW OF A VISCOUS INFINITELY ELECTRICALLY CONDUCTING FLUID PAST A POROUS FLAT PLATE IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. A. S. Gupta (Indian Inst. of Tech., Kharagpur). Appl. Sci. Research, 9B: 201-4(1961). (In English)

An analysis is made for a uniform shear flow of an incompressible, viscous, and perfectly electrically conducting fluid past a porous flat plate in the presence of a transverse magnetic field. It is shown that in the case of suction an asymptotic profile similar to that of Griffith and Meredith (for the flow of an incompressible viscous fluid past a porous plate) exists if the suction velocity is greater than the Alfvén velocity. In the case of injection, however, the asymptotic profile will exist if the Alfvén velocity is greater than the velocity of injection. (auth)

5471 HEAT TRANSFER OF A TWO-PHASE FLOW WITH A CLUSTER OF PIPES. I. T. Elperin (Minsk Inst. of Power Engineering, Academy of Sciences). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 8, 30-5 (Aug. 1961). (In Russian)

A method of intensifying convective heat transfer from gas to the heating surface by introducing into the gaseous medium an intermediate liquid heat transfer agent is described. Results are given of preliminary investigations of aerodynamics and heat transfer of a two-phase gas-liquid heat transfer agent with a cluster of pipes. Investigations showed a slight increase in the resistance of the model and an essential increase in the rate of heat transfer when an intermediate liquid heat transfer agent was introduced. (auth)

5472 NATURAL CONVECTION BETWEEN HEATED VERTICAL PLATES IN A HORIZONTAL MAGNETIC FIELD. J. Fletcher Osterle and Frederick J. Young (Carnegie Inst. of Tech., Pittsburgh). J. Fluid Mech., 11: 512-18(Dec. 1961).

The effect of viscous dissipation and applied magnetic field is investigated for the case of the fully developed natural convection of a fluid between two heated walls. When electrical and viscous dissipation is negligible, short-circuited Hartmann flow results. The deviation of the velocity and temperature profiles from those existing in Hartmann flow are presented for various Hartmann numbers when dissipation is not neglected. It is shown that increasing the applied magnetic field rapidly decreases the influence of both viscous and joulean dissipation on the velocity and temperature profiles. (auth)

5473 MAGNETOHYDRODYNAMIC FLOWS OF A PERFECTLY CONDUCTING, VISCOUS FLUID. F. A. Goldsworthy (Univ. of Manchester, Eng.). J. Fluid Mech., 11: 519-28(Dec. 1961).

The flow of an incompressible, viscous, perfectly conducting fluid past a fixed obstacle in the presence of an applied magnetic field, which is parallel to the stream at large distances from the obstacle, is considered. A simple transformation of the fluid velocity and the total head enables the magnetohydrodynamic flow past the obstacle to be determined from the corresponding flow of a nonconducting fluid past the same obstacle but with a reduced main-stream velocity. The method is illustrated by considering the flows past a sphere, a circular cylinder, and a semi-infinite flat plate for different field strengths. The drag on the sphere is plotted as a function of the field strength for a fixed Reynolds number. The patterns of the flow past a circular cylinder are sketched and an inference is made to the way in which disturbances can propagate upstream for the case when the main-stream velocity is less than the Alfvén speed. These give rise in the first instance to a separation bubble upstream of the cylinder. Finally the range of applicability of familiar high Reynolds number approximations to magnetohydrodynamic flows is discussed. In particular, if the main-stream velocity is equal to the Alfvén speed, the boundary-layer approximation is shown to be no longer valid. (auth)

5474 HEAT TRANSFER BY FREE CONVECTION IN A LIQUID METAL. F. J. Bayley, P. A. Milne, and D. E. Stoddart (Kings Coll., Newcastle-upon-Tyne, Eng.). Proc. Roy. Soc. (London), A265: 97-108(Dec. 19, 1961).

An experimental investigation of the free convection heat transfer process under the special conditions associated with a liquid metal of high thermal conductivity is described. Using an apparatus employing the thermosyphon principle, and a means of wall-temperature measurement which avoided many of the difficulties often associated with liquid metals, data were obtained over a wide range of laminar and turbulent boundary-layer flow. Results are in satisfactory agreement with existing theoretical data; in the turbulent region they are a direct extrapolation of those from the laminar regime, showing that molecular conductivity remains the principal means of transferring heat, even when there is significant macroscopic motion. (auth)

5475 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. William George Hutchinson (to United Kingdom Atomic Energy Authority). British Patent 885,292. Dec. 20, 1961.

A heat exchanger is designed for sodium-water heat exchange. The heat exchanger comprises two tube arrays, one for sodium and the other for water, fitted into copper blocks which have gaps to facilitate close fit with the tubes and which provde a heat transfer path between the two tube arrays. (D.L.C.)

5476 IMPROVEMENTS IN THERMAL EXCHANGE INSTALLATIONS. Andre Huet. British Patent 885,398. Dec. 28, 1961.

A heat exchange installation, similar to those described in British Patents 822,417, 823,904, and 838,742, which are split up into a number of separate units supplied by headers, is designed for reduction of the height of the casing tubes. In this installation, either the superheaters or the economizers or both are disposed in the supply headers and/or discharge headers, preferredly in subheaders fitted on the main headers. (D.L.C.)

5477 HEAT EXCHANGE INSTALLATION. A. Huet. First Add. 74,930 to French Patent 1,199,599. Jan. 23, 1961.

The French Patent 1,199,599 described an installation with an evaporator enclosed in a main casing through which the heating gases circulated. The steam-water separation was effected, not in the evaporator, but in a supplementary separator casing that was in communication with the evaporator inside the former main casing. The water separated from the steam left the separator casing at the bottom and was fed via a pump in the lower extremity of the evaporator. This pump had a by-pass for natural circulation. According to the present addition, the high pressure exit of the pump is connected to the by-pass piping via an injector tube mounted in the axis of a part of the by-pass line shaped like a venturi tube, so that the end of this injector tube is situated in the narrowest cross section of the venturi tube, this injection favoring the said natural circulation. (NPO)

5478 IMPROVEMENTS IN HEAT EXCHANGERS. (to Babcock & Wilcox Ltd.). French Patent 1,228,660. Aug. 31, 1960.

A boiler suitable for a nuclear power plant includes a cylindrical pressure vessel arranged to lie with its axis substantially horizontal. Above the level of the pressure vessel, a vapor liquid separating drum is disposed and pipes are arranged, respectively, to conduct the vapor and liquid mixture from an upper region of the pressure vessel to said separating drum and to conduct liquid from the drum for circulation thereof to a lower region of the pressure vessel. Inside the pressure vessel, heat exchange surfaces are disposed constituted by tubes arranged for internal flow of the heating gas and forming a part of the vapor generating section. At least one other section is further disposed in series with the vapor generating section and formed by tubes arranged for external flow of the heating gas transversely of the tubes. Suitably, the vapor generating section is arranged for natural circulation of the working medium of the boiler with that medium rising upwardly and transversely with respect to the tubes of the vapor generating section. Preferably, a portion of the tube bank, providing vapor generation surfaces and situated adjacent the gas outlet, serves as an economizer. (NPO)

5479 VALVE CONTROLLED PIPING SYSTEM FOR THE FLOW OF A FLUID FROM THE HEAT SOURCE TO THE HEAT EXCHANGER. (to United Kingdom Atomic Energy Authority). French Patent 1,234,624. Oct. 18, 1960.

In order to avoid too high expansions in the gas conduits, it has previously been proposed to connect the reactor with the heat exchanger by a coaxial double pipe, so that the hot gas flows in the inner pipe, while the cold gas flows inside the annular interspace bounded by the two pipes. A valve is described for controlling simultaneously the flow of both the hot and the cold gas. The extremities of the two pipes reach into the casing of the heat exchanger and the said annular interspace is closed at these extremities but communicates with the heat exchanger space at the open extremity of the said inner pipe via lateral openings in this pipe. The inner pipe is further connected with the hot end of the heat exchanger via a lateral branch provided at a point further from the end than the lateral openings. In said inner pipe there slides a collar provided with a median dividing wall, this collar closing progressively and simultaneously by axial or rotary movement the said lateral openings and the entrance of the said lateral branch. This movement is controlled by a rod passing through the outer wall of the heat exchanger. (NPO)

Instrumentation

Refer also to abstracts 5176 and 5582

5480 (APEX-284) USE OF GAMMA SCINTILLATION COUNTER TO MEASURE FUEL CONTENT OF METALLIC FUEL SHEETS. Charles L. Brown (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 24, 1956. Decl. June 9, 1961. Contracts AF33(038)-21102 and AT(11-1)-171. 13p.

Two types of gamma scintillation counters used to check the fuel content in the cores of rolled billets are described. The calibration of the machines by utilizing statistical correlation techniques and the method of maintaining machine control and accuracy are discussed. By the use of control charts a comparison of accuracy and precision is made between the machines and a wet chemistry analytical method. (auth)

5481 (CEA-2038) MACHINE A CONTROLER LE LINGE DU POINT DE VUE DE SA CONTAMINATION RADIOACTIVE. (Machine for Checking the Radioactive Contamination of Clothing). R. Mimaud and S. Cottignies (France. Commissariat à l'Énergie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). 1961. 9p.

The machine is designed to check working clothes after decontamination treatment. It checks automatically for α and β-γ. The clothing is carried on a moving belt under a rack of Geiger-Müller counters followed by zinc sulfide scintillators linked to photomultipliers. During its passage under these probes two separate counting systems count the β-γ and the α activities. If a certain fixed rate is reached, a basket reserved for contaminated linen moves into position in front of the belt to collect the clothing; if this rate is not attained the linen is collected in another basket. The starting and stopping of counting, and the return to zero, are controlled by means of 3 photoelectric cells which detect the arrival of the clothing before and after scanning, and its delivery into the baskets. (auth)

5482 (CF-61-5-109(Suppl.2)) CALIBRATION OF NUDE IONIZATION GAUGES. Supplement No. 2. C. E. Normand (Oak Ridge National Lab., Tenn.). Nov. 24, 1961. Contract [W-7405-eng-26]. 17p.

A series of simultaneous calibrations of nude and tabulated ionization gages was carried out. Gage response was compared with independently derived pressure change. Nude ionization gages showed both sensitivity and additive errors. (M.C.G.)

5483 (DC-55-11-112) ELIMINATION OF NOISE PULSES FROM THE FISSION CHAMBER BY COATING INSULATORS WITH A CONDUCTING SURFACE. R. R. Swope (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 14, 1955. Contract AT(11-1)-171. 5p.

Difficulty was encountered from noise pulses because of vibrations of the fission chamber while taking data. The elimination of this noise is possible through the use of insulators coated with a conducting material. The material to use for the metallic coat must be determined. Because of the desirability and availability of Ag and Pt in liquid form, these materials were chosen. The metallic liquid is applied to the insulators by painting with a brush where possible and the inside of the tube by flowing, allowing it to set and then firing it. Unless the coat is uniform and adherent, it cannot be used. While the Ag coating turned out best for tubes, that of Pt was best for the discs. (auth)

5484 (DC-57-1-141) EVALUATION OF THE DENSITY GAGE FOR HYDROGEN ANALYSIS IN SOLID MODERATORS. D. M. McCutcheon (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 24, 1957. Changed from Secret July 26, 1961. Contract AT(11-1)-171. 12p.

A review of results obtained in test runs made on the Ohmart Density Gage for determination of H in ZrH is presented. The performance accuracy, interference factors and operating limitations are discussed. It was found that the H measurements should be made in hex pieces which are rough bored. A gage modification to correct for wall thickness in the test specimen is required. (J.R.D.)

5485 (DC-57-7-42) DETERMINATION OF DAMPING COEFFICIENT OF PNEUMATIC AMPLIFIER. B. Kaplan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 27, 1957. Contract AT(11-1)-171. 14p.

Methods are given for determining the damping coefficient of a pneumatic amplifier by comparing the analytical solution of the equation of motion with experimental results. (auth)

5486 (DC-57-7-57) Σ PILE MEASUREMENT REPORT NO. 1. J. N. Renaker and V. J. Stratton (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 11, 1957. Contract AT(11-1)-171. 15p.

An ion chamber was calibrated in slot 10S of the ANP Σ pile by means of indium foil activations. An average sub-cadmium flux of 7.4×10^3 neutrons per square centimeter per second incident upon the active volume of the chamber gave rise to a current of 6.8×10^2 $\mu\mu$ amp. (auth)

5487 (DLCS-4000101) AUTOMATIC DATA LOGGING AND COMPUTING SYSTEM PERFORMANCE TEST. Test Evaluation T-641333. Section 1. W. E. Haas (Duquesne Light Co., Shippingport, Penna.). First issue, Dec. 6, 1961. 40p.

A test was carried out to check the Automatic Data Logging and Computing System to assure that it was not damaged during shipping and/or installation. The following tests were performed with satisfactory results: the "all commands," "memory worse case pattern," and "all characters—typewriters and IBM card punch." It was found while performing the "multiplexer test" that certain patchboard points gave data other than what was expected when either shorted-out or open circuit. The "DADIT and a-c/d-c converter stability test" was performed several times in an attempt to derive the stability of the particular combination of a-c/d-c converter and DADIT then in the computer. (M.C.G.)

5488 (DP-659) A TRAVELLING FLUX MONITOR FOR EXPONENTIAL PILES. William J. Woodward (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1961. Contract AT(07-2)-1. 16p.

A traveling monitor was designed and constructed for use in the Subcritical Experiment and the Pressurized Subcritical Experiment facilities at the Savannah River Laboratory. The instrument records the axial neutron flux distribution by plotting a continuous curve position as a function of current from a gamma-compensated ion chamber. (auth)

5489 (EURAEC-161) SOLID STATE NEUTRON DETECTOR. Quarterly Progress Report No. 3, April–June 1961. (Brussels. Centre d'Etude de l'Energie Nucleaire). Aug. 1961. Work performed under United States-Euratom Joint Research and Development Program. Contract [029-60-10RDB]. 23p.

The effect of reactor irradiation on the behavior of diodes is discussed. It was assumed that some of the diodes have a p-i-n structure, which changes into a p-s-n structure by the introduction of donor impurities upon reactor irradiation. As a consequence of this change the slope of the semilogarithmically plotted forward characteristics increases from q/2 kT to q/kT, as was observed at a neutron dose of 10^{15} neutrons/cm^2. It was observed that the saturation current decreases at the same dose and this was in agreement with the fact that the saturation current of a p-s-n structure is less than that of a p-i-n structure. The increase of the photo-current upon irradiation with U.V. light, at this neutron dose meant that the photosensitivity or the photosensitive volume increased in the intrinsic region which might happen as a result of a shift of the Fermi level. Hall and resistivity measurements were started with n-type silicon carbide in a temperature range between 300 and 1000°K. With rising temperature the conductivity first showed the typical temperature dependence $\sigma = \sigma_0 e^{-(\epsilon/kT)}$ but went through a maximum at about 600°K. The Hall coefficient decreased with increasing temperature. The charge carrier concentration, calculated from the Hall coefficient, varied between 10^{17} (300°K) and 10^{18} (1000°K) electrons/cm^3. The ionization energy of the donor impurities, calculated from the change in charge carrier concentration with temperature was found to be 0.092 ev. The mobility $R\sigma$ varied between 10 and 20 cm^2 V^{-1} sec^{-1}, with a maximum at about 375°K. (auth)

5490 (HW-70366) NPR PROCESS TUBE MONITORING. P. J. Pankaskie (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 8, 1961. Contract AT(45-1)-1350. 9p.

A program was undertaken to develop the necessary system of in-reactor measurements and examinations for monitoring of zircaloy pressure tubes. Methods for remote visual examination and detection and measurement of process tube deformation, unusual corrosion, and hydrogen pickup are described. (M.C.G.)

5491 (JINR-P-782) DIFFERENTSIAL'NYI GAZOVYI CHERENKOVSKII SCHETCHIK. (A Differential Gas Čerenkov Counter). A. S. Vovenko, B. A. Kulakov, M. F. Likhachev, A. L. Lyubimov, Yu. A. Matulenko, I. A. Savin, and V. S. Stavinskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 11p.

A differential gas Čerenkov counter is described which was used for the determination of the total cross sections for K-p interactions in the momentum range 3 to 5 Bev. A method for determining a particle beam momentum with such a counter is indicated. (auth)

5492 (JÜL-20-RE) VERWENDUNG VON HALBLEITERZÄHLERN ZUM NACHWEIS VON GELADENEN TEILCHEN UND NEUTRONEN. (Use of Semiconductor Counters for Detection of Charged Particles and Neutrons). H. J. Bormann (Kernforschungsanlage, Jülich, Germany). Aug. 30, 1961. 17p.

The investigations of semiconductor counters showed that for various applications in the recording and spectrometry of charged particles and neutrons advantages exist in comparison with conventional detectors. The advantages are good resolving power, low working voltage, and small size. Disadvantages consist first of all in the necessity for large amplification of the generated impulse and in a relatively short lifetime at irradiation by about 10^{13} particles per cm^2; this especially plays a role in measurements in a strong neutron field. (tr-auth)

5493 (NDL-TR-13) THERMAL AND FAST NEUTRON EFFECTS ON DOSIMETER FILMS. Robert J. Smith (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.). Oct. 1961. 41p.

To accurately measure the initial gamma radiation from atomic detonations, the effect of neutrons on gamma detectors was evaluated. Eight film types, encased in NBS holders and covering a range of 0.3 to 50,000 r, were exposed to thermal- and fast-neutron radiation. The lithium extrapolation method was used in the evaluation. Points which seem evident concerning the fast-neutron sensitivity of film are that the sensitivity of the film increases with increasing neutron energy from 1 to 14 Mev and that the ratio of the sensitivity of the film is roughly equal to the reciprocal of the ratio of their grain sizes. (auth)

5494 (NP-11190) MEGAVOLT ELECTRONICS, SUBMILLIMETER WAVE RESEARCH. Annual Report, March 1, 1960–February 28, 1961. (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). Mar. 1, 1961. Contract AF33(616)-7043. 121p.

Research on the Cherenkov radiation approach to the millimeter and sub-millimeter generation problem is described. The method involves a combination of megavolt electronics and physical optics type techniques. A scalar dielectric, Cherenkov coupler operating at 8.31 millimeters wavelength produced 58 milliwatts per centimeters using a drive current of 43 milliamperes. The analysis and preliminary design of Cherenkov experiments in tensor media (ferrites, plasmas) is presented which shows promise of producing upwards of 100 watts with a 10 milliampere beam. Initial numerical analysis for a relativistic electron bunching accelerator (Rebatron) operating above 3 kmc is presented. (auth)

5495 (NP-11204) ELEMENTS OF RADIATION DOSIMETRY. Richard Madey (Republic Aviation Corp., Farmingdale, N. Y.). July 27, 1961. 40p. (SRS-TR-31-(383)).

The concepts of radiation exposure dose, absorbed dose, and biological dose resulting from ionizing particles are reviewed. The units used in radiation measurements are defined, and the concept of electronic equilibrium is discussed. The Bragg-Gray cavity relation is used to calculate the absorbed dose from measured ionization and to relate the absorbed dose to the exposure dose under electronic equilibrium conditions. Differences between absorbed dose and exposure dose are illustrated. Limitations of the concept of RBE dose are discussed. (C.H.)

5496 (NYO-9585) APPLICATIONS OF ULTRASONIC ENERGY. ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. Bimonthly Progress Report No. 29, August 1, 1961—September 30, 1961. (Aeroprojects, Inc., West Chester, Penna.). Oct. 1961. Contract AT(30-1)-1836. 11p.

The application of ultrasonic techniques to nuclear reactor instrumentation is currently being investigated in the area of gaseous dispersions of fine particles. The simple tests previously reported have been elaborated upon, and the ability to detect frequency shifts in a resonant column due to different carrier gases and to particle loadings of about 2 lb/ft^3 has been demonstrated. A method for improving signal-to-noise ratio is reported. (auth)

5497 (ORNL-3169) CALCULATION OF THE PULSE-HEIGHT RESPONSE OF NaI(Tl) SCINTILLATION COUNTERS. C. D. Zerby and H. S. Moran (Oak Ridge National Lab., Tenn.). Jan. 3, 1962. Contract W-7405-eng-26. 50p.

A Monte Carlo calculation to determine the pulse-height response of NaI(Tl) scintillation counters to gamma rays is described. Comparisons of several calculations with experiments using 3-in.-dia by 3-in.-high crystals for source energies from 0.32 to 7.48 Mev are presented and show good agreement at large pulse heights. At small pulse heights the calculations underestimated the experimental data and indicated that background radiation can contribute significantly to the experimental results. An extensive series of calculations are reported for a 3-in.-dia by 3-in.-high crystal using monoenergetic, point isotropic sources placed on the crystal axis 10 cm from one end. The source energy ranged from 0.1 to 6.0 Mev in this series of calculations. (auth)

5498 (SCTM-248-61(72)) UNDERGROUND ODOMETERS. H. C. Hardee, Jr. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1961. Contract [AT(29-1)-789]. 23p.

The purpose of the underground odometer is to measure earth movement, both transient and permanent, in the vicinity of an underground explosion. Two different gages, the rack and pinion gage and the helical spline gage, are discussed. Models of both these gages were built and tested. The rack and pinion gage proved to be the more accurate and versatile of the two. (auth)

5499 (WAPD-AD-TH-512) TRANSIENT RESPONSE OF WATER TEMPERATURE THERMOCOUPLES. E. W. Fink (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 10, 1959. Contract AT(11-1)-gen-14. 18p.

A method of estimating transient time constants for coolant water thermocouples is presented. The method involves measuring the transient response to a step change in temperature produced by a rapid immersion in a liquid bath. Assuming that the response is linear, the resulting time constant for any given thermocouple is inversely proportional to the forced convection heat transfer coefficient between the bath fluid and the thermocouple bead. Thus, it is possible to produce a relationship between the measured time constant and those properties of the bath fluid which affect its heat transfer coefficient. This relationship can then be used to estimate the transient response of individual thermocouples under actual operating conditions provided that the heat transfer properties of the fluid in which the thermocouple is immersed can be estimated. Immersion test procedures and analytical techniques for applying this technique are given. Response time for several exposed junction (bared wire) thermocouple probes were obtained. (auth)

5500 (WAPD-T-1380) CALCULATED AND MEASURED NEUTRON ENERGY SPECTRAL DISTRIBUTIONS USING THE THRESHOLD DETECTOR TECHNIQUES. W. D. Lanning and K. W. Brown (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1961. Contract AT(11-1)-Gen-14. 18p.

Presented at ANS Meeting, Chicago, Nov. 1961.

An experimental program was undertaken to verify present calculational methods for obtaining the spatial variation of the neutron spectrum. Several types of threshold detectors were irradiated in a hydrogen moderated region directly outside of the pressure vessel of a power reactor. Activation rates were obtained for each type of detector and the data were reduced to the energy spectrum by analytical methods. Various methods for performing this reduction are discussed. The experimentally determined activation rates for four detectors, S^{32}, U^{238}, Np^{237}, and Pu^{239}, were reduced by the orthonormal expansion method using an exponential weight function. The spectral distributions representing the extreme cases of the analysis were normalized to the multigroup P-1 result at 3 Mev. Comparison between the experimentally determined spectra and the P1MG calculation indicated reasonably good agreement in the valid region of comparison, the low energy range. (M.C.G.)

5501 (CEA-tr-R-1393) DÉTECTEUR À SCINTILLATIONS DES NEUTRONS RAPIDES. (Scintillation Detector for Fast Neutrons). Yu. (Iu.) Khudenskii and Yu. (Iu.) A. Tsirlin. Translated into French by B. De Trezvinsky from Russian Patent 124,557. Oct. 9, 1958. 4p.

A scintillation detector for fast neutrons, using recoil protons, is constructed of transparent scintillation plastic material. In order to decrease the scintillation intensity of secondary electrons and, consequently, to decrease the sensitivity to γ rays, the layers of scintillating plastic are separated by layers of nonscintillating plastic. The detector described has a nonscintillating layer which is thicker than the scintillating layers in order to give a given sensitivity to the neutron flux along the length of the axis. (tr-auth)

5502 (CEA-tr-X-404) L'EFFET DE LA RÉFLEXION TOTALE SUR LA CONSTRUCTION (CALCUL DES DIMENSIONS) DES COLLIMATEURS DE NEUTRONS. (The Effect of Total Reflection on the Construction (Calculation of Dimensions) of Neutron Collimators). Pal Szabo. Translated into French from Magyar Tudomanyos Akad. Központi Fiz. Kutató Intézetenek Közlemenyei, 7: 257-62(1959). 8p.

The effect of total reflection in calculations of optimum dimensions for neutron collimators is examined. These effects are produced on the walls of the primary collimators of crystal spectrometers and neutron spectrometers. Formulas are given for calculating the intensity after a single total reflection. The formulas prove that the dimensions of collimators have an optimum from the viewpoint of the intensity which proceeds in this way (and similarly to the intensity which proceeds directly). In the two cases this optimum is the same in practice. (tr-auth)

5503 (FTD-TT-61-213) A METHOD FOR AERIAL SURVEYING OF RADIOACTIVE ELEMENTS. V. A. Ionov, N. D. Balyasnyi (Balyasnyy), A. V. Dmitriev (Dmitriyev), and I. M. Nazarov. Translated from Russian Patent No. 133538. Byull. Izobret., No. 22, 25-8(1960). 3p.

A scintillation spectrometer was adopted for use in aerial surveys over great areas of natural radioactive elements in rocks. A multi-channel amplitude analyzer, and devices for measuring background radioactivity and correcting for flight altitude were designed for use with the spectrometer. The measurements are made within a restricted solid angle, and the spectrum is analyzed by means of the narrow differential channels of the amplitude analyzer located at the sites of the characteristic lines of the gamma spectrum of the respective elements. The information from several channels, corresponding to the lines of some element, is summed and the measurement results are processed during flight by means of a computer. Standardization is accomplished above control sectors with known uniform radioactive element content. (C.H.)

5504 (JPRS-11288) PARAMETERS OF RADIOACTIVE RELAYS. Jerzy Czarnecki. Translated from Nukleonika, 6: No. 2, 85-96(1961). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 3222.

5505 AN INEXPENSIVE MULTIFREQUENCY PULSE GENERATOR FOR CALIBRATING RADIATION RATEMETERS. Richard P. Marquiss and Ronald L. Kathren (Mare Island Naval Shipyard, Vallejo, Calif.). Am. Ind. Hg. Assoc. J., 22: 455-8(Dec. 1961).

A pulse generator suitable for use in calibrating radiation rate-meters is described. Basically employing a simple multivibrator circuit, the device provides pulse rates ranging from 30 to 200 thousand pulses per minute. Stability and reproducibility of pulse rate was found to be good. The entire unit can be built from ordinary parts at a cost of approximately twenty-five dollars. (auth)

5506 RADIATION ALARM PEDESTAL. William H. Ray (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Am. Ind. Hyg. Assoc. J., 22: 494-6(Dec. 1961).

Ion chamber radiation survey instruments have been equipped with a contact-making meter. They are also equipped with an ordinary electrical receptacle so they may be plugged in to a pedestal when not being used to make a survey. The pedestal may be located to keep the instrument in a convenient position for the user. The pedestal contains a battery-powered alarm which will sound when the radiation dose rate attains the level at which the contact meter is set. (auth)

5507 MEASUREMENT OF VERY HIGH TEMPERATURES. A. S. Kaufman (Hebrew Univ., Jerusalem). Instr. Pract., [14:] 502-7(May 1960).

Following a brief discussion of temperature and temperature equilibrium in an optically thin plasma, most of the known methods of measuring ion and electron temperatures in various thermonuclear devices, where temperatures exceeding 10^5°K are attained, are considered. The physical principles underlying the more important measurements are clarified, and the value of each method is appraised. (auth)

5508 THEORY OF MULTICHANNEL COLLIMATED SCINTILLATION DETECTORS. J. Myhill (Royal North Shore Hospital of Sydney, Crows Nest, New South Wales, Australia). Intern. J. Appl. Radiation and Isotopes, 12: 10-19(Nov. 1961). (In English)

A theory of the spatial response of multichannel collimated scintillation detectors is developed which includes the effects of radiation penetrating the septa between channels of the collimator. The calculated values of detector response function half-widths are in agreement with the experimental values published by others. (auth)

5509 EVALUATION OF METHOD FOR COUNTING GROSS RADIOACTIVITY IN WATER. J. W. Mullins, R. C. Kroner, D. G. Ballinger, and H. P. Kramer (Robert A. Taft Sanitary Engineering Center, Cincinnati). J. Am. Water Works Assoc., 53: 1466-72(Dec. 1961).

The detection and measurement of radioactivity in water is discussed with respect to the evaluation of methods for counting gross radioactivity. The results obtained when two samples of water containing a radioisotope were sent to various laboratories are presented. Approximately half the agencies were able to determine gross radioactivity within 10 to 15% of the true activity. The majority of the reported values were significantly below the true activity, suggesting that the true radioactivity of environmental samples may be higher than currently reported. In the preparation of water samples for counting, a solids drying temperature of not more than 100°C must be maintained to prevent loss of volatile radioisotopes. Of the available standards for instrument calibration, either thallium-204 or cesium-137 appears to be satisfactory for beta counting, and cesium-137 appears to be satisfactory as a gamma standard. The use of other standards tends to affect the reliability of the results adversely. In the gross counting of water samples for beta radioactivity, a solids thickness of 20 mg/cm^2 or less is imperative. The internal proportional counter is the instrument of choice for the counting of gross beta activity, although the end-window counter may yield satisfactory results if geometry factors are rigidly controlled. (N.W.R.)

5510 THE MEASUREMENT OF RADIOACTIVITY OF NATURAL POTASSIUM. Isamu Koizumi (Industrial Research Inst. of Kanagawa, Japan). J. At. Energy Soc. Japan, 3: 858-61(Nov. 1961). (In Japanese)

Radioactivities of solutions of potassium salt of different liquid thickness were measured with a thin walled cylindrical counter. It was found that the γ-β count rate ratio depends on the sample thickness. Therefore when the sample thicknesses are much different, the counting rate should not be regarded as a linear function of potassium content. In order to estimate the count rate regardless of the liquid thickness, the following two equations were derived: $A = 2la \int_r^R x \cdot \exp\{-\mu(x-r)\} \text{ arc tg} \cdot [r'l/2(\sqrt{x^2 - r'^2}\sqrt{l^2/4 + x^2 - r'^2})]\, dx$ and $N = A \cdot \epsilon \cdot \exp\{-\mu'(r - r')\}$, where A is the number of the particles incident on counter window, N the counting rate, r and r' the outer and inner radius of counter respectively, l its length, R the radius of cylindrical sample, a the number of disintegration rate occurring per unit volume of sample, x the distance from central axis of the counter to any point in sample, μ and μ' linear absorption coefficients of sample and wall material of counter respectively, and ϵ the intrinsic efficiency of counter. Counting rates thus estimated were in good agreement with observations. With these equations the absolute radioactivity can be estimated from observed counting rate. (auth)

5511 I.N.S. TYPE 20 CHANNEL PULSE HEIGHT ANALYZER. Masao Otsuka and Kazuo Omata (Tokyo Univ.). J. At. Energy Soc. Japan, 3: 862-7(Nov. 1961). (In Japanese)

Performance and adjustment methods are reported. This instrument is suitable for use with 2μs delay-line shaped pulses having a rise time in the range 0.2 to 0.5 μs, a decay time 8 μs or more, and a rate of 10000 cps or less. Adjustment accuracy of channel width is kept within ±2% and level drift is 0.1 to 0.2 v. (auth)

5512 SHOCK TUBE BETA-RAY DENSITOMETER. M. McChesney (Univ. of Liverpool). J. Sci. Instr., 38: 496-500(Dec. 1961).

A method for measuring the varying density behind a hypersonic shock wave in air using the absorption of β particles is described. Calculated absorption curves are given for typical β ray energies over the full range of initial downstream pressures encountered in shock tubes. The scintillator, photomultiplier, detector circuit is discussed and an illustrative calculation of source size and accuracy of measurement is given for the case of S^{35}. (auth)

5513 ISOTOPIC DISCRIMINATION INTRODUCED BY ELECTRON MULTIPLIER DETECTORS IN MASS SPECTROMETRY. B. L. Campbell and R. N. Whittem (Australian Atomic Energy Commission, Sydney). J. Sci. Instr., 38: 516(Dec. 1961).

Using a Metropolitan-Vickers mass spectrometer type MS5, a 90° sector instrument of 12 in. radius, employing an 11-stage Be–Cu multiplier, the multiplier discrimination was measured in two cases, U^{235}/U^{238} and Sr^{84}/Sr^{88}. The factors were determined by comparing ion ratios obtained using multiplier detection and conventional plate detection. So that amplifier non-linearities and range factors would not influence the result, synthetic samples having approximately unit ratio of the selected isotopes were used. The results show a significant deviation from the simple velocity correction, and are in line with those previously obtained by others for lithium. (P.C.H.)

5514 METHOD OF MEASURING THE MÖSSBAUER EFFECT. J. E. S. Bradley and J. Marks (Middlesex Hospital Medical School, London). Nature, 192: 1176-7 (Dec. 23, 1961).

A system designed to overcome such disadvantages as are encountered in measuring the Mössbauer effect is shown schematically. The entire assembly, which can fit into the working gap of an electromagnet, is described in detail. (P.C.H.)

5515 MEASURING MACHINE FOR BUBBLE CHAMBER PHOTOGRAPHS. B. B. Culwick and S. J. Goldsack (Univ. of Birmingham, Eng.). Nuclear Instr. & Methods, 13: 118-23(Sept. 1961). (In English)

A semi-automatic measuring machine is described which is primarily designed for analyzing the tracks of particles in a bubble chamber. The accuracy of a measurement on the film is about 2.5 microns in each coordinate, and measurements can be made at a rate of one every few seconds. (auth)

5516 AN AUTOMATIC TRACK FOLLOWING DEVICE. G. A. Doran and M. Jobes (Univ. of Birmingham, Eng.). Nuclear Instr. & Methods, 13: 124-6(Sept. 1961). (In English)

A method of automatic track following which is used on the measuring machine for bubble chamber photographs is described. An error signal is derived from the relative positions of the peak of the track pulse and a marker pulse. Correction signals are then applied to servo-motors to reverse the sign of the error signal. A non-linear system is used; the magnitude of the correction signal is constant but its sign is changed when the sign of the error signal changes. An electrical signal to print out co-ordinates is produced when the error signal is zero. (auth)

5517 OPERATION OF A 9-INCH BUBBLE CHAMBER WITH DEUTERIUM. W. P. Dodd, G. A. Doran, J. B. Kinson, L. Riddiford, and B. Tallini (Univ. of Birmingham, Eng.). Nuclear Instr. & Methods, 13: 127-30(Sept. 1961). (In English)

A 9-inch bubble chamber in a pulsed magnetic field was successfully operated with deuterium. The closed circuit system for the use and storage of the deuterium is described. The operating conditions of the chamber are discussed, and compared with those of the same chamber when used with hydrogen. (auth)

5518 COINCIDENCE SUMMING AND NON-LINEARITY STUDIES WITH A TWO-CRYSTAL SCINTILLATION GAMMA SPECTROMETER. J. Kantele and R. W. Fink (Univ. of Arkansas, Fayetteville). Nuclear Instr. & Methods, 13: 141-6(Sept. 1961). (In English)

A two-crystal 4π NaI(Tl) scintillation gamma spectrometer is used for studying coincidence summing effects with special reference to the energy calibration in the region 0.5 to 4 Mev of coincidence sum peaks of cascade gammas. From observed deviations of the sum peak positions from those expected according to calibrations with single photopeaks, the nonlinear response of NaI(Tl) is investigated. The pulse height per unit energy as a function of energy appears to approach a constant value with increasing energy up to 4 Mev. A slight shift in single photopeak position when collimation is introduced is observed at most gamma energies with a single crystal spectrometer. Possible reasons for the apparent nonlinearity are discussed. (auth)

5519 A FAST PULSE-SHAPE DISCRIMINATOR WITH APPLICATIONS AS A SPECTROMETER AND SENSITIVE MONITOR FOR 1-30 MEV NEUTRONS. L. J. De Vries and F. Udo (Inst. for Nuclear Physics Research, Amsterdam). Nuclear Instr. & Methods, 13: 153-60(Sept. 1961). (In English)

The construction and operation is described of a neutron-gamma discrimination circuit. The discrimination is based on the differences in the shapes of light pulses initiated by protons and electrons in an organic crystal. The circuit separates these pulses above a proton energy of 0.5 Mev. The response to a gamma-source can be calculated as a pile-up effect with a time constant of about 0.1 μsec. The circuit is independent of normal temperature fluctuations and the multiplier voltage can be varied by 20 per cent. The circuit is applied as a fast neutron spectrometer. The efficiency is 1.3×10^{-4} counts/neutron and the resolution 10 per cent at 14 Mev neutron energy. A neutron monitor is designed, based on this circuit. This instrument can measure neutron fluxes down to 10 per cent of the maximum permissible dose and it can present information about the neutron spectra. (auth)

5520 EXPERIENCES IN THE USE OF SCINTILLATION DETECTOR IN A β-SPECTROMETER OF TOROID-SECTOR TYPE. D. Berényi and Gy. Máthé (Hungarian Academy of Sciences, Debrecen). Nuclear Instr. & Methods, 13: 161-8(Sept. 1961). (In English)

Experiences are reported regarding the adjustment of the electronic parameters and other operating conditions of a scintillation spectrometer used as a detector in a β spectrometer of the toroid-sector type. Anthracene crystals and plastic phosphors were applied as scintillators, while the multipliers were types RCA 6342-A and 5819 respectively. The adjustment of the optimal parameters and the investigation of the operating conditions of the detector were carried out by taking the signal-to-noise characteristics and pulse-height distributions as well as by determining the efficiency curve of detection. (auth)

5521 THE DOUBLE-GRID IONIZATION CHAMBER. Iwao Ogawa, Tadayoshi Doke, and Masahiro Tsukuda (Rikkyo (St. Paul's) Univ., Tokyo). Nuclear Instr. & Methods, 13: 169-76(Sept. 1961). (In English)

A new type of gridded ionization chamber is described. The chamber is provided with two sheets of grid between the cathode and the collector. Signals are taken out not only from the collector, but also from the grid closer to the cathode simultaneously. While the collector pulses afford the information on the energy of particles, the grid pulses give the information on the direction of emission. The other grid facing the collector is grounded and serves as a screen grid. Owing to the efficient shielding action of this screen grid, it is possible to make full use of the grid pulses while keeping the energy resolution better than 1 to 2%. Several applications of the chamber are shown, including the improved electronic collimation, low-background counting, and the measurement of angular distribution of proton recoils. (auth)

5522 FAST TUNNEL DIODE CIRCUITS FOR NaI(Tl) DETECTORS. Georges C. Bret and Erwin F. Shrader (Case Inst. of Tech., Cleveland). Nuclear Instr. & Methods, 13: 177-82(Sept. 1961). (In English)

A detector system using a NaI(Tl) crystal, an RCA 6810A photomultiplier, and a tunnel diode discriminator is described. The output from the anode of the high gain photomultiplier corresponding to the emission of three photoelectrons from the photocathode even though it is not big enough to drive an electron tube from cut off to saturation can, however, easily trigger a tunnel diode fast discriminator. The system introduces a 4 mμsec spread in time when detecting gamma rays over a wide range of energies and only 1 mμsec when a 10% energy selection is performed using a parallel slow channel. A tunnel diode time-to-pulse height converter having a resolving time better than 2 mμsec which can be used in conjunction with the system is also described. (auth)

5523 IMPROVED FISSION COUNTING METHOD FOR URANIUM ISOTOPE ANALYSIS. Goesta Nilsson (Aktiebolaget Atomenergi, Stockholm). Nuclear Instr. & Methods, 13: 183-9(Sept. 1961). (In English)

The fission rates of an unknown sample and a standard sample are compared by a simultaneous fission counting of the samples when placed back-to-back in a pile neutron flux, the ratio of the uranium contents of the samples is determined spectrophotometrically and ϵ = atom % U^{235} (unknown)/atom % U^{235} (standard) thereby calculated. The useful range of this method was extended by increasing the resolving power of the fission counter, the systematic error in ϵ was re-determined and found to be within 0.04% and the precision was increased. It was thus found using 100 to 140 μg samples of uranium that, in the range 0.72 to 100% U^{235}, ϵ in a single determination can be determined with a precision of ±0.7% with 95% confidence limits. Almost the same relative precision in atom % U^{235} of the unknown sample can be obtained by using as standard samples uranium isotope standards from the National Bureau of Standards. (auth)

5524 A MINIATURE FAST FISSION COUNTER. G. D. Hickman (Knolls Atomic Power Lab., Schenectady, N. Y.). Nuclear Instr. & Methods, 13: 190-6(Sept. 1961). (In English)

A small, ¼ inch diameter by ½ inch in length, fast neutron fission counter probe employing highly depleted uranium as the fission material is developed. The isotopic analysis of the uranium, obtained by the 3-stage mass spectrometer is as follows: U^{238} (essentially 100%), U^{236} (0.03 ± 0.02 ppm), U^{235} (0.90 ± 0.20 ppm), and U^{234} (0.04 ± 0.02 ppm). The uranium was plated out of solution to a yield of approximately 1.72 mg/cm^2. Detailed measurements of the fast neutron flux in the Flexible Plastic Reactor (10^5 to 10^6 ncm^{-2} sec^{-1}) at KAPL, obtained with the U^{238} fission counter, have shown it to be insensitive to both thermal neutrons and high energy (>5.3 Mev) gamma rays. The photofission of the U_3O_8 was checked in the critical assembly by making a fast neutron scan with red phosphorus (½″ × ⅒″) pellets. Since the (n,p) threshold reaction in phosphorus (≈1 Mev) is approximately the same as the (n,f) reaction in U^{238}, the two scans should yield, as is found to be the case, identical results provided there is no appreciable influence of photofission in the U_3O_8. (auth)

5525 100 Mc/s TUNNEL-DIODE DISCRIMINATOR AND PULSE-SHAPER. A. Adler, M. Palmai, and V. Perez-Mendez (Hebrew Univ., Jerusalem). Nuclear Instr. & Methods, 13: 197-200(Sept. 1961). (In English)

A discriminator circuit for use with nanosecond pulses at high repetition rates is described. Fast tunnel diodes are used in both the discriminating and pulse shaping stages. The effect of circuit parameters on the operation of the tunnel diode stages is discussed, and the results of various measurements on the performance of the circuit are given. (auth)

5526 SURFACE-BARRIER DIODES FOR NUCLEAR PARTICLE DETECTION. J. Bok and J. P. Noel (Centre d'Etudes Nucléaires, Fontenay aux Roses, France). Nuclear Instr. & Methods, 13: 206-10(Sept. 1961). (In French)

A method is described for the preparation of p-n junctions by surface-barrier for nuclear particle detection. The method used is the surface oxidation. Ozone is employed to stabilize the inversion layer. The main characteristics of this detector and the results obtained are given. (auth)

5527 MEASUREMENTS OF INSTRUMENTAL TIME DELAY AND RESOLUTION IN A FAST COINCIDENCE SYSTEM. W. M. Currie, R. E. Azuma, and G. M. Lewis (Glasgow Univ.). Nuclear Instr. & Methods, 13: 215-23(Sept. 1961). (In English)

An experimental investigation is made of the instrumental time delays and resolution of a fast coincidence system as a function of the energy liberated in the scintillators. This is done for NaI(Tl), anthracene, plastic, and liquid scintillators whose decay times, relative efficiencies, and photo electron yields are also investigated. The results serve to assess some of the errors and limitations inherent in the measurement of very short times, and give some indication of their causes. (auth)

5528 CALCULATION OF RECOIL SPECTRA INDUCED BY FAST NEUTRON SPECTRA IN NUCLEAR EMULSIONS. Hans Deckers (Studiecentrum voor Kernenergie, Mol, Belgium). Nuclear Instr. & Methods, 13: 224-30(Sept. 1961). (In English)

In fast neutron spectroscopy using nuclear emulsions, the relation between the neutron spectrum and the proton spectrum is generally deduced from the properties of the neutron-proton scattering. From the experiments performed it appears that it is advantageous to measure the spectrum of the range projected on the plane of the emulsion only, taking into account the geometry of the exposure. Thus, a mathematical basis is provided for the analysis of data obtained under such conditions. In the case of complex neutron spectra, range straggling in the emulsion is accounted for. Both the analytical and the Monte-Carlo method are dealt with. Finally a correlated sampling method is described which yields a very accurate calculation of the recoil spectrum induced by a fission spectrum. (auth)

5529 A PROPANE BUBBLE CHAMBER WITH MECHANICAL EXPANSION. D. W. Anderson and J. McKenzie (Clarendon Lab., Oxford). Nuclear Instr. & Methods, 13: 231-7(Sept. 1961). (In English)

A description is given of a propane bubble chamber with a sensitive volume of one liter, in which the expansion is effected by a mechanical method. A flywheel driven by a small electric motor provides a reservoir of mechanical energy, and the energy for an expansion is withdrawn through a magnetic clutch. Such an assembly is compact and readily transportable, and the recycling rate can be once per second. Information is given concerning the possible size of chamber that could be operated by this technique, using commercially available magnetic clutches. (auth)

5530 SIMULTANEOUS NUCLIDE IDENTIFICATION AND ENERGY MEASUREMENT OF NUCLEAR REACTION PRODUCTS. Carl E. Anderson, D. A. Bromley, and M. Sachs (Yale Univ., New Haven). Nuclear Instr. & Methods, 13: 238-43(Sept. 1961). (In English)

A system of particle detectors is developed which measures the kinetic energy of nuclear reaction products and identifies their charge and mass. The method of identification is based on the Bethe-Bloch equation for the rate of energy loss of a fast heavy particle. These detectors extend this method to the identification of the isotopes of heavy reaction products such as lithium, beryllium, boron, carbon, nitrogen, and oxygen. (auth)

5531 AN AMPLITUDE-INSENSITIVE SYSTEM THAT DISTINGUISHES PULSES OF DIFFERENT SHAPES. T. K. Alexander and F. S. Goulding (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Instr. & Methods, 13: 244-6(Sept. 1961). (In English)

A method of pulse-shape discrimination is described in which the slow-to-total charge ratio is measured at a photomultiplier dynode. The ratio determination is approximately independent of amplitude over at least a 10 : 1 operating range. The performance of the system as a particle discriminator selecting neutrons in a background of γ rays is shown for stilbene and a liquid scintillation counter. The time required to determine the shape of a pulse is about 1 μs and could be less. Thus errors due to pulse pile-up at high counting rates are not serious. The system uses a conventional amplifying system requiring only a single dynode pulse. No special photomultiplier or very fast circuits are required since the charge in the fast component is measured and no attempt is made to follow its fast rise. These features enable the system to be tested effectively with artificial pulses from a test-pulse generator. (auth)

5532 A RANDOM PULSE GENERATOR WITH PROVISION FOR EXCURSIONS. R. J. Lamden (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 13: 247-52(Sept. 1961). (In English)

A generator is described which is capable of producing pulses occurring randomly in time. The mean pulse rate may be set between 10 c/s and 100 kc/s. In addition, the mean rate can be made to increase exponentially with time, and a range of time-constants between 30 ms and 10 s is provided. The output of the generator at a constant mean rate may be used for testing scalers, ratemeters, time-to-pulse-height converters, and other instruments which have to operate with randomly timed input pulses and may show defects with such pulses which are not apparent with a uniform input. The output with an excursion in the mean rate is particularly suitable for testing reactor period trip units and similar equipment. (auth)

5533 AN INSTANTANEOUS PULSE FREQUENCY METER FOR RANDOM PULSES. K. Gopalan and E. S. Rajagopal (Indian Inst. of Science, Bangalore). Nuclear Instr. & Methods, 13: 253-7(Sept. 1961). (In English)

Counting-rate meters normally used for finding pulse frequencies are sluggish in their response to any rapid change in the pulse repetition frequency (P.R.F.). An instrument is described which measures each pulse interval and provides immediately afterwards an output voltage proportional to the reciprocal of interval duration. A response to a change in the P.R.F. as rapidly as is physically possible is obtained. The instrument has wide application in low level radiation detection and in several other fields especially for rapidly varying counting-rates. (auth)

5534 SPARK COUNTER AS A FAST PULSE GENERATOR. S. L. Gupta and N. K. Saha (Univ. of Delhi). Nuclear Instr. & Methods, 13: 258-60(Sept. 1961). (In English)

The spark counter is used as a fast pulse generator for testing fast coincidence circuits and its behavior studied in detail using a Bell type of coincidence arrangement. The rise time of the spark counter pulse is estimated to be less than 4 nanosec. (auth)

5535 THE ESTIMATION OF THE RESOLVING TIME OF A COUNTING APPARATUS. G. R. Martin (Univ. of Durham, Eng.). Nuclear Instr. & Methods, 13: 263(Sept. 1961). (In English)

The resolving time of a counting apparatus is usually fixed by an electronically imposed paralysis of duration determined by circuit parameters, however, it is useful to have an independent check on the resolving time. If the apparatus is of the type in which the dead time is not extended by the occurrence of a further event during the recovery period, then $N = n/(1 - n\tau)$, where n is the observed counting rate, N the true rate, and τ the resolving time of the apparatus. For a pure radioactive substance, $N = N_0e^{-\lambda t}$, and may be re-written as $ne^{\lambda t} = N_0 - nN_0\tau$. A simple plot of $ne^{\lambda t}$ against n should then be linear, and from the ratio of slope ($N_0\tau$) to intercept (N_0), τ may immediately be evaluated. An example is presented of the method to a beta-proportional counter set, using 2.576 hour manganese-56 as the active material; a value of 57.9 μsec is deduced for the effective dead time of the apparatus. (N.W.R.)

5536 A TWO STAGE MASS SPECTROMETER FOR NUCLEAR PHYSICS APPLICATIONS. H. W. Wilson, R. Munro, R. W. D. Hardy, and N. R. Daly (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 13: 269-81(Oct. 1961). (In English)

The design of the mass spectrometer described makes it useful in nuclear physics applications. Two 90° magnetic stages, each of 15-in. radius, are used together with an accelerating voltage of 15 kv. Scanning is by variation of the accelerating potential, the magnetic fields being held constant to one part in 10^5 by nuclear magnetic resonance. Organic materials are excluded with consequent reduction in "hydrocarbon" background. The design of the spectrometer is described and the performance discussed. (auth)

5537 A FAST PULSE SHAPING CIRCUIT WITH AMPLITUDE DISCRIMINATOR USING TUNNEL DIODES. S. Gorodetzky, A. Muser, J. Zen, and R. Armbruster (Institut de Recherches Nucléaires, Strasbourg). Nuclear Instr. & Methods, 13: 282-6(Oct. 1961). (In French)

A fast pulse shaping circuit with amplitude discriminator using tunnel diodes is described. The threshold is adjustable from 5 to 50 ma. The output pulse has a standard amplitude (0.3 v) and length (5 nanoseconds). The circuit is to be used for a fast coincidence technique. (auth)

5538 CALCULATION OF POLE PIECE SURFACES IN A MAGNETIC SPECTROMETER. H. U. Gersch (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Nuclear Instr. & Methods, 13: 297-304(Oct. 1961). (In German)

For a high-resolving flat spectrometer with 190-degree focusing, the surfaces of the pole pieces were calculated using conformal mapping. The perturbation of the magnetic field near the edges was considered. The influence of the exciting coil and hysteresis effects are also discussed. A general method is developed to calculate the correction to be applied to the pole pieces, if the field produced by them deviates slightly from the prescribed field. (auth)

5539 SOLID-STATE DETECTOR FOR MONITORING 14-MEV NEUTRON PRODUCTION. R. Cedarlund, A. Horn, and M. Scolnick (Univ. of California, Livermore). Nuclear Instr. & Methods, 13: 305-8(Oct. 1961). (In English)

The use of a silicon p-n junction as an alpha monitor for the H^2(H^3,n^1)He^4 reaction on the Cockcroft-Walton accelerator is described. The use of the p-n junction to monitor the proton contribution from the D-D reaction is also mentioned. Various graphs illustrate alpha and proton pulse-height distributions, their dependence on bias voltage, and the ratio proton pulse height vs bias voltage. Conclusions are reported to alpha pulse height. (auth)

5540 OPTIMUM LOCATION OF BF$_3$ COUNTERS IN A NEUTRON MODERATOR. C. W. Peters and A. L. Snyder (U. S. Naval Research Lab., Washington, D. C.). Nuclear Instr. & Methods, 13: 309-12(Oct. 1961). (In English)

A method was developed for determining the optimum location of BF$_3$ counters in a moderating medium, such as water. This method, which gives a maximum sensitivity to a neutron flux with a given energy spectrum, requires the use of data on the interaction characteristics for sets of two and three counters and the relative count rate profiles along the axis of symmetry of the moderator and along a line perpendicular to the axis of symmetry. Experimental verification is presented for the case of three BF$_3$ counters in a rectangular water moderator. (auth)

5541 AN IMPROVED Li^6-LOADED GLASS SCINTILLATOR FOR NEUTRON DETECTION. F. W. K. Firk (Oak Ridge National Lab., Tenn.), G. G. Slaughter, and R. J. Ginther. Nuclear Instr. & Methods, 13: 313-16(Oct. 1961). (In English)

A cerium activated, Li^6-loaded, glass scintillator of improved scintillation efficiency and Li^6 content was developed and used for detecting neutrons with energies from thermal to 80 kev by time-of-flight techniques. The following properties of a glass scintillator ($\approx$ 1.5" thick) with 0.045 × 10^{24} Li^6 atoms/cm^2 were determined: an efficiency of 20% for detecting neutrons of 1-kev energy, a negligible background due to γ-rays of energy < 1.3-Mev, a resolution of 25% for the Li^6(n,α)T peak, a pulse with rise time $\approx$ 4 nanosec and a decay $\approx$ 100 nanosec into an impedance of 100 ohms, and a time resolution < 2 nanosec when using a "fast-slow" coincidence system and annihilation quanta from Na^{22}. These properties were exploited in measuring the neutron energy spectrum from the reaction Li^7(p,n)Be^7 using the ORNL pulsed Van de Graaff and the associated nanosec time-of-flight spectrometer. For a proton energy 15 kev above the reaction threshold the neutron energy spectrum extended from 5 to 80 kev. Neutron transmission measurements up to several kev also demonstrate the use of the scintillator with a fast chopper neutron spectrometer. Lithium and boron loaded glass scintillators were compared and it is concluded that lithium glass is, in general, the more suitable for neutron detection. (auth)

5542 A NEW DESIGN OF A MULTIPLE-WIRE SPARK COUNTER AND SOME STUDIES WITH THE SINGLE WIRE-PLATE SPARK COUNTER. Gurbax Singh and N. K. Saha (Univ. of Delhi, India). Nuclear Instr. & Methods, 13: 321-9(Oct. 1961). (In English)

A new design of multiple-wire spark counter is described which eliminates almost completely the mutual interaction between the individual counter wires. The counter shows a long plateau (3.3 to 6 kv) for alpha particle detection with practically no slope. The new design results in a considerable improvement in the neutron counting efficiency over the earlier records. The alpha counting efficiency of a single wire-plate spark counter is studied at partial pressures of water, methyl alcohol and ethyl alcohol. A marked effect is observed which shows a close relationship with the diffusivity of these vapours in air. The effect of irradiation by strong beta, gamma and ultraviolet rays on the alpha counting behavior of the counter is evaluated. (auth)

5543 PRECISION MEASUREMENTS OF NUCLEAR g-FACTORS BY THE TIME-TO-PULSE-HEIGHT CONVERTER METHOD. Eckart Matthias and Torsten Lindqvist (Univ. of Uppsala). Nuclear Instr. & Methods, 13: 356-8(Oct. 1961). (In English)

A method is suggested in which the differential angular correlation technique is used in combination with a time-to-pulse-height converter and a multi-channel analyzer. It is possible to study carefully how the angular correlation pattern varies with time during a precession caused by an external magnetic field. As the precession can be followed for several turns, the accuracy of the g-factor measurement is correspondingly higher. (auth)

5544 AN INVESTIGATION INTO THE MECHANISM OF SELF-QUENCHING GEIGER-MÜLLER COUNTERS CONTAINING ARGON WITH SMALL QUANTITIES OF XENON, OXYGEN, AND NITROGEN. A. J. L. Collinson, I. C. Demetsopoullos, and J. M. Zarzycki (Borough Polytechnic, London). Proc. Phys. Soc. (London), 78: 785-800(Nov. 15, 1961).

The time distribution of spurious pulses in counters with treated and untreated cathodes was studied by pulse interval analysis; and plateau characteristics, charge per pulse, and Geiger threshold potential are plotted as functions of the xenon concentration. In all the counters investigated, the presence of a minimum threshold indicates an optimum xenon concentration 3.5%. Measurements of the corona threshold with argon and argon–xenon filling mixtures show a pressure dependent increase in gas multiplication with addition of xenon. This increase in ionization is tentatively explained by the hypothesis of two-body collisions between xenon atoms and argon excited molecules leading to the formation of the molecular ion AXe$^+$. Mobilities obtained from transit time measurements identify the ions involved as A$_2^+$(1.82 cm sec^{-1}(v cm^{-1})$^{-1}$), possibly NO^+(2.45 cm $sec^{-1}(v\ cm^{-1})^{-1}$), this ion appearing after the counters is in continuous discharge, and an ion of mobility 1.64 cm $sec^{-1}(v\ cm^{-1})^{-1}$, which is not inconsistent with the postulated AXe^+ molecular ion. (auth)

5545 COUNTING TIMES REQUIRED WITH NEUTRON SOIL-MOISTURE PROBES. Robert A. Merriam and Kenneth R. Knoerr (Foresters, Watershed Management Research [Calif.]). Soil Sci., 92: 394-5(Dec. 1961).

Reasonable precision in measuring water content of soils with a nuclear probe can be obtained for soils at all moisture contents with a constant counting time of 2 min. Procedures used in the calibration of neutron probes are discussed. (C.H.)

5546 ADJUSTMENT OF SINGLE-CRYSTAL SPECIMENS FOR NEUTRON DIFFRACTION STUDIES. I. I. Yamzin and Yu. Z. Nozik (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst., 6: 374-7 (Nov.-Dec. 1961).

Single-crystal specimens are oriented in accordance with the Laue patterns in special x-ray cameras of the Soviet Union. The axis of the investigated zone of planes is perpendicular or parallel to the x-ray beam. The oriented specimen is fixed in a standard detachable crystal holder and is transferred together with the latter to the neutron diffractometer. No further adjustment of the specimen in the neutron beam is required. Two Soviet-made x-ray back-reflection cameras are described. In both methods described using these instruments, the error in the intensity determination is 5 to 10%. (N.W.R.)

5547 RADIATION FUEL GAUGE. Donald Franklin Howard (to North American Aviation, Inc.). British Patent 885,102. Dec. 20, 1961.

A fuel gage is designed for measuring the mass of a fluid in a container, particularly an irregularly shaped aircraft fuel tank. The gage comprises a gamma source positioned adjacent the container and a radiation-sensitive means detecting the radiation attenuated by the fluid in the container. A servo means is connected with the detector to convert its signal into an output signal, and an indicator means is provided which is responsive to the output signal and which is calibrated to take into account the geometric shape of the container. (D.L.C.)

Materials Testing

5548 INVESTIGATION OF FUEL ELEMENTS IN A HIGH-TEMPERATURE LOOP TEST. C. B. von der Decken (Brown Boveri/Krupp Reaktorbau GmbH., Jülich, Ger.). Tech. Mitt. Krupp, 19: 173-81(Nov. 1961). (In German)

Fission products are classified according to volatility. Service conditions of spherical fuel elements of uranium carbide and graphite in a high-temperature reactor are discussed. Experimental facilities are described. Results of diffusion measurements for Xe^{133}, Xe^{135}, Kr^{85m}, and Kr^{87} from uranium carbide cartridges are given. Diffusion of inert gases in graphite is discussed. Results obtained in measuring diffusion from the fuel elements, using different grades of graphite are presented and discussed. The importance of inert gases of long half life in cooling system contamination is also discussed. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

5549 (A/AC.82/G/L.664) FALLOUT OVER U.A.R. FROM THE FOURTH FRENCH NUCLEAR TEST OVER ALGERIAN SAHARA. K. A. Mahmoud (United Arab Republic. Atomic Energy Establishment, Inshas, Egypt). Aug. 1961. 11p.

Data corresponding to the arrival of debris from the nuclear test over Algerian Sahara to both regions of U.A.R. are summarized. Samples of fall-out on the ground were collected daily, and preliminary investigations showed fission product contents corresponding to a deposition of 10 mc/km^2. Samples of airborne radioactive materials were collected daily at breathing air level. The formation and behavior of radioactive clouds on the date of the explosion is also discussed. Data are also given on internal and external doses received from fall-out debris. (P.C.H.)

5550 (A/AC.82/G/L.690) THE CONCENTRATIONS OF ^{90}Sr AND ^{137}Cs IN LAND WATERS IN JAPAN. Noboru Yamagata, Takahisa Hanya, and Shu Nagayama (Institute of Public Health. Radiation Health Lab., Tokyo). 7p. Aug. 1961.

Cesium-137 and strontium-90 concentrations in land waters in Japan are tabulated, and a brief discussion is given on the run-off of these radionuclides from rivers. As one of the extreme cases in land waters, ground waters collected from a spring at the shore of Lake Haruna did not contain measurable amounts of Sr^{90}. The contrary case was observed in stagnant lake waters. The concentration of Sr^{90} in tap water varies in response to its resource. The average concentration of Sr^{90} in river waters in Japan is roughly estimated as 0.1-0.2 $\mu\mu$c/l in 1960. The concentration of Cs^{137} in river waters is considerably lower than that of Sr^{90}. (P.C.H.)

5551 (A/AC.82/G/L.697) PENETRATION OF ARTIFICIAL RADIOACTIVITY IN DEEP WATERS OF THE PACIFIC AND VERTICAL DIFFUSION RATE OF SEA WATER. Y. Miyake, K. Saruhashi, Y. Katsuragi, and T. Kanazawa (Meteorological Research Inst., Tokyo). Aug. 1961. 12p.

Vertical penetration of Sr^{90} and Cs^{137} down to 5,000 m depth was confirmed in the western North Pacific. Surface values of these radioisotopes ranged from 0.6 to 3.1 $\mu\mu$c/l for Sr^{90} and from 0.8 to 4.8 $\mu\mu$c/l for Cs^{137}, while values at 5,000 m depth were about 0.1 $\mu\mu$c/l for both. From the vertical variation in the concentration of radioisotopes, the vertical diffusion coefficient from 200 to 4,000 m depth was calculated and the value of 200 was obtained. Using the value of 200 for the vertical eddy diffusivity, the time required for complete vertical mixing of about 700 years was obtained for that portion of the Pacific Ocean. (auth)

5552 (A/AC.82/G/L.698) SEASONAL VARIATION OF RADIOACTIVE FALLOUT. Y. Miyake, K. Saruhashi, Y. Katsuragi, and T. Kanazawa (Meteorological Research Inst., Tokyo). Aug. 1961. 18p.

Discussion is given on the so-called spring maximum in the annual change of radioactive fall-out. The spring maximum is caused by the subsidence of the upper air from the northern regions due to troughs and jet streams. It is found that when a rain is associated with a trough at 500 mb and above and when a jet stream is simultaneously located right above or a little south above Tokyo, the specific activity of rain water increases approximately by three times. Such weather conditions appear frequently from March to June in the temperate zone. (auth)

5553 (A/AC.82/G/R.183) RAPPORT VAN DE COMMISSIE DER KONINKLIJKE NEDERLANDSE AKADEMIE VAN WETENSCHAPPEN BETREFFENDE DE GEVAREN, DIE KUNNEN ONTSTAAN TENGEVOLGE VAN DE VERSPREIDING VAN RADIOACTIEVE PRODUKTEN DOOR EXPERIMENTELE KERNENERGIE-EXPLOSIES. (Report of the Commission of the Royal Dutch Academy of Sciences Regarding Hazards, Which Can Arise as a Result of the Diffusion of Radioactive Products from Experimental Nuclear Explosions). (Netherlands. Koninklijke Nederlandse Akademie van Wetenschappen, Amsterdam). 1957. 48p.

The radioactivity released locally by a nuclear bomb explosion is described, and its dessimination by air currents is discussed. The accumulation of radioactive debris in the atmosphere and the biological dangers resulting are summarized. The advisability of continued atmospheric testing is discussed in the conclusion. (J.S.R.)

5554 (ANL-6444) WEATHER MODIFICATION. M. B. Rodin and D. C. Hess (Argonne National Lab., Ill.). Dec. 1961. Contract W-31-109-eng-38. 18p.

It is suggested that applying heat directly to a rain cloud, or to a moist air mass with rain potential, may alter the natural precipitation in a given geographical region. The immediate effect of the heat is to increase the buoyancy of the cloud or air parcel. The result, which depends on a number of interrelated factors may be either to cause precipitation where it would not naturally occur, or to suppress precipitation where it would naturally occur. Several possible applications are suggested. Since the heat supplied is supplemented by the latent heat resulting from condensation in the moist air mass, the results may more than justify the cost. However, substantial amounts of heat are involved. The heat can be supplied from fossil fuels, nuclear reactions, or a combination of both; but the logistics favor the use of large nuclear reactors wherever safety criteria can be met. Not only the efficiency and economics of the process, but also its feasibility, can be finally decided only on the basis of information that is not now available. (auth)

5555 (TID-14471) GEOLOGIC ASPECTS OF THORIUM RECOVERY FROM COMMON ROCKS. Quarterly Progress Report, September 1, 1961 through November 30, 1961. (Rice Univ., Houston, Tex.). [Dec. 1, 1961]. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26, Subcontract 1491. 32p.

Results are reported from a survey of thorium reserves in New Hampshire. Field work was concentrated on the Conway granite, which constitutes about 60% of the outcrop area of the main White Mountain mass, and contains the highest known concentration of Th. Results of petrographic and statistical studies of rocks are tabulated. (C.H.)

5556 (UCRL-13026) SOURCES OF INFORMATION ON ROCK PHYSICS. CURRENT LITERATURE, OCTOBER 1961. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Oct. 30, 1961. For Univ. of California Lawrence Radiation Lab., Livermore. Contract [W-7405-Eng-48], Purchase Order No. 8912807. 85p.

Abstracts are included with the references in most cases. The information is presented in general categories on physical properties, rock formation, loading, engineering applications, seismology, wave propagation, and instruments and methods. (About 230 references). (J.R.D.)

5557 (UCRL-13030) SOURCES OF INFORMATION ON ROCK PHYSICS. CURRENT LITERATURE, NOVEMBER 1961. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Nov. 30, 1961. For Univ. of California Lawrence Radiation Lab., Livermore. Contract [W-7405-Eng-48]. 118p.

A bibliography on rock physics is presented. The summaries of the articles are given under the following topics: physical properties, rock deformation, loadings, engineering applications, seismologies, wave propagation, and instruments and methods. The material covered is that made available at the Colorado School of Mines, Arthur Lakes Library during November 1961. An author index is included. (M.C.G.)

5558 (CEA-tr-R-1251) IDENTIFICATION DES MINERAUX DU GROUPE DES FERGUSONITES PAR L'ANALYSE AUX RAYONS X. (Identification of the Minerals of the Fergusonite Group by X-Ray Analysis). A. I. Komkov. Translated into French from Zapiski Vsesoyuz. Mineral. Obshchestva, 88: 655-60(1959). 19p.

In order to establish the possibility of identification, with x-ray diagrams, of different minerals of the fergusonite group, various compounds of variable composition $(Y,Nb)TaO_4$ and $(Y,RE)NbO_4$, where RE is the rare earth, were synthesized and studied. The relations between the defraction constants and the density were established as a function of the composition in the isomorphic series $YNbO_4$–$YTaO_4$ and $YNbO_4$–$(Y,TR)NbO_4$. These relationships can be used for the quantitative evaluation of the ratio Nb/Ta in natural samples of minerals of the fergusonite groups and also for the qualitative or semiquantitative determination of the concentration of different groups of the rare earth elements. The problems of preliminary thermal treatment of the metamictic mineral samples of fergusonite minerals necessary before proceeding to x-ray analysis are discussed. (tr-auth)

5559 CARBONATIC NIOBIUM-RARE EARTH DEPOSITS, RAVALLI COUNTY, MONTANA. E. William Heinrich and A. A. Levinson (Univ. of Michigan, Ann Arbor and Dow Chemical Co., Freeport, Tex.). Am. Mineralogist, 46: 1424-47(Nov.-Dec. 1961).

Carbonatic Nb–RE deposits of Ravalli County, Montana, contain chiefly dolomite and Sr–Ba calcite and variable amounts of biotite, chlorite, actinolite, allanite, quartz, barite, apatite, monazite, pyrite, magnetite, and columbite. Rarer unusual constituents are ancylite, fersmite, niobian rutile, eschynite, andradite, glaucophane, and wollastonite. The tabular deposits which are in pre-Beltian hornblendic metamorphic rocks are an inch to 10 feet thick, as much as 450 feet long, and crosscutting as well as conformable. They range in texture and composition from metasomatized marble layers to banded, comb-structure veins, resulting from the action of hydrothermal solutions of alkalic derivation, which supplied mainly Sr, Ba, RE, Nb, and S. (auth)

5560 ANALYSIS OF RADIOACTIVE DISEQUILIBRIUM IN URANIUM MINERALS BY ALPHA SPECTRUM. Hisao Takahashi (St. Paul's Univ., Japan), Toru Murano, and Tadayoshi Doke. J. At. Energy Soc. Japan, 3: 874-8 (Nov. 1961). (In English)

The radioactive equilibrium state in uranium ores from Ningyō-tōge was studied by α spectrum measurements with a gridded ionization chamber. Although the degree of equilibrium could not be quantitatively determined because of sample thickness, the disequilibrium was confirmed. An autunite sample was particularly poor in radium content as compared to ionium and uranium contents. The age of this sample was estimated to be less than 10^3 yr. (auth)

5561 AN EVALUATION OF URANIUM AS A TOOL FOR STUDYING THE HYDROGEOCHEMISTRY OF THE TRUCKEE MEADOWS AREA, NEVADA. Philip Cohen (U. S. Geological Survey, Carson City, Nev.). J. Geophys. Research, 66: 4199-4206(Dec. 1961).

Forty-seven water samples collected in the Truckee Meadows, an alluviated intermontane basin in western Nevada, were analyzed for uranium and for the principal dissolved constituents. Some of the relationships between uranium and other chemical constituents described by other writers are verified in the study of the hydrogeochemistry of the Truckee Meadows area; others are not. The following relationships between uranium and bicarbonate-plus-carbonate content, uranium and chloride content, and uranium and sulfate content were observed in the waters of the Truckee Meadows area: uranium content tends to increase as the bicarbonate-plus-carbonate content increases; thermal, chloride-rich waters of the Steamboat Springs area are relatively deficient in uranium; and some waters high in sulfate content are relatively rich in uranium; others are not. Because of the variability in concentration and the complex interrelationships between the bicarbonate, carbonate, sulfate, and chloride anions, and because uranium content appears to be dependent upon these variables, uranium has little value as a tool for studying the hydrogeochemistry of the area. (auth)

5562 AN ADDITIONAL MEASUREMENT OF THE TRITIUM CONTENT OF ATMOSPHERIC HYDROGEN OF 1949. E. L. Fireman and F. S. Rowland (Brookhaven National Lab., Upton, N. Y.). J. Geophys. Research, 66: 4321(Dec. 1961). (BNL-5682)

A sample was collected on Aug. 4, 1949, and measured for tritium activity in September 1953. A T/H ratio of $(5.7 \pm 1.0) \times 10^{-15}$ was obtained, corrected to the time of collection. Independent measurements performed on a sample taken in the spring of 1952, in the same apparatus as before, yielded results of $(16.6 \pm 1.0) \times 10^{-15}$ and $(16.7 \pm 1.2) \times 10^{-15}$ for T/H. (L.N.N.)

5563 TRANSMISSION AND SCATTERING PROPERTIES OF A NEVADA DESERT ATMOSPHERE UNDER CLOUDY CONDITIONS. Mathew G. Gibbons, Frank I. Laughridge, John R. Nichols, and Nicholas A. Krause (Naval Radiological Defense Lab., San Francisco). J. Opt. Soc. Am., 52: 38-43(Jan. 1962).

The angular scattering diagram of a Nevada desert atmosphere was measured under clear sky and cloudy conditions for radiation of 0.40-, 0.45-, 0.50-, and 0.55-μ wavelengths, and attenuation coefficients for scattering and absorption were determined for radiation of 0.40-, 0.50-, 0.70-, and 0.83-μ wavelengths. The ratio R of scattered-in to direct radiation received from a 4-π source by a flat receiver facing the source was also determined for the latter wavelengths, both with and without cloud cover. Source-receiver distances D of from 1.07 to 17.15 miles were used. Plots of R vs. D are presented which show that under conditions of little or no cloud cover, R for each of the four wavelengths increases monotonically with D out to a distance of 17.15 miles, whereas for the case of full overcast at 4000 ft above ground, R increases with D for distances up to about 10 miles and then decreases with increasing distance at least for the next few miles. For lower cloud heights, the maximum in R appears to move to smaller distances, approximately in proportion to cloud height. (auth)

5564 MICROBAROGRAPH RECORDS FROM THE RUSSIAN LARGE NUCLEAR EXPLOSIONS. E. W. Carpenter, G. Harwood, and T. Whiteside (Atomic Weapons Research Establishment, Southend-on-Sea, Essex, Eng.). Nature, 192: 857(Dec. 2, 1961).

During the recent series of Russian atomic weapon tests, microbarographs were obtained from several of the larger firings at Novaya Zemyla and particularly from the 50 megaton firing of October 30. Taking the origin time as 08.33 hr from a study of the seismic signal, the start of the first characteristic microbarograph record was observed 3 hr 11 min later at 11.44 hr; subsequent to this, clear signals were obtained at approximately 16.40 hr on October 31; 00.10 hr on November 1; and 12.40 hr on November 2. It appears that the waves are being successively reflected at the antipodes of Novaya Zemyla and at Novaya Zemyla, with relatively little absorption or scattering. (P.C.H.)

5565 LOSS OF FLUORESCENT PARTICLES IN ATMOSPHERIC DIFFUSION EXPERIMENTS BY COMPARISON WITH RADIOXENON TRACER. A. E. J. Eggleton (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and N. Thompson. Nature, 192: 935-6(Dec. 9, 1961).

A decrease in the number of air-borne fluorescent particles of zinc cadmium sulfide with increasing distances of travel was demonstrated in an experiment in which xenon-133 was used as an inert gaseous tracer. Results are tabulated. The mean loss of particles in traveling between the two sampling stations was approximately 50%. Ratios from the two assessments were almost identical. (C.H.)

5566 ROUND-THE-WORLD SOUND WAVES PRODUCED BY THE NUCLEAR EXPLOSION ON OCTOBER 30, 1961, AND THEIR EFFECT ON THE IONOSPHERE AT SODANKYLA. G. Rose (Max-Planck-Institut für Aeronomie, Lindau Harz, Ger.), J. Oksman, and E. Kataja. Nature, 192: 1173-4(Dec. 23, 1961).

The heavy nuclear explosion on October 30, 1961, at 8.33.33 G.M.T. at a distance of 1160 km in Novaya Zemlya was recorded at Sodankylä by means of a seismograph, a microbarograph, a magnetograph, and a vertical incidence ionosonde. On October 31, the microbarograph again showed two very distinct and strong deflections, namely, at 18.32 and 21.28 G.M.T. These deflections are interpreted as being caused by round-the-world waves due to the same nuclear explosion, one being propagated in the backward, the other in the forward direction. The mean velocity deduced from these round-the-world waves is 311 m/sec. It is reasonably assumed that these waves are strong enough to cause a detectable ionospheric effect when passing over Sodankyla. (P.C.H.)

5567 STUDIES ON THE BEHAVIOR OF RAW AND LEACHED ORES IN THE ATMOSPHERIC CONDITIONS. Rafal Wlodarski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 601-13(1961). (In Polish)

The influence of atmospheric conditions on the behavior of uranium and radium contained in ore was investigated. It is shown that atmospheric water, leaks through ores and washes radium and uranium in quantities considerably higher than the permissible levels for waters. (auth)

5568 ON THE AIRBORNE RADIOACTIVITY IN THE LOWER REGIONS OF THE ATMOSPHERE IN THE CITIES OF PUEBLA AND MONTERREY. [PART] II. Augusto Moreno Moreno and Eugenia Ramirez de Arellano (Universidad Nacional, Mexico (City)). Rev. mex. fis., 10: 219-28(1961). (In Spanish)

The total beta radioactivity of the lowest layers of the atmosphere was studied by filter collection of the air-carried dust. Data are presented for Puebla and Monterrey in 1959. (auth)

5569 SOURCES AND ISOTOPIC COMPOSITION OF ATMOSPHERIC SULFUR. M. L. Jensen and N. Nakai (Yale Univ., New Haven). Science, 134: 2102-4(Dec. 29, 1961).

In nonindustrial areas the prime source of SO_4^{2-} in rain and snow is atmospherically oxidized H_2S that is produced predominantly along coastal belts by anaerobic bacteria. The δ S^{34} analyses of atmospheric SO_4^{2-} vary from +3.2 to +15.6 per mil in contrast to +20.7 per mil for sea water SO_4^{2-}. Contrary to previous studies based on Cl^-/SO_4^{2-} ratios, sea spray SO_4^{2-} is a minor source. (auth)

5570 CHATTANOOGA SHALE AND RELATED ROCKS OF CENTRAL TENNESSEE AND NEARBY AREAS. Louis C. Conant and Vernon E. Swanson (Geological Survey, Washington, D. C.). Geological Survey Professional Paper 357. 1961. 97p. (GPO)

The Chattanooga shale crops out on the steep slope between the Nashville basin and the surrounding Highland Rim, and on many high hills within the basin in Tennessee. Outside the basin the black shale sequence is exposed in several river valleys and around the large Lexington Basin of Kentucky, Ohio, and Indiana. It also crops out along the ridges and valleys of the folded Appalachians in Tennessee, Georgia, and Alabama. Information is presented on the stratigraphy, composition, structure, paleography, and origin of the Chattanooga shale. Its relationship to the underlying and overlying formations is discussed. (C.H.)

5571 GEOLOGICAL SURVEY RESEARCH, 1961. SYNOPSIS OF GEOLOGIC AND HYDROLOGIC RESULTS. (Geological Survey, Washington, D. C.). Geological Survey Professional Paper 424-A. 1961. 206p. (GPO).

A synopsis of geologic and hydrologic results obtained by the Geological Survey in 1961 is presented. A list of investigations in progress in the Geologic and Water Resources Divisions is given. A bibliography is included. (M.C.G.)

5572 GEOLOGICAL SURVEY RESEARCH, 1961. SHORT PAPERS IN THE GEOLOGIC AND HYDROLOGIC SCIENCES, ARTICLES 1-146. (Geological Survey, Washington, D. C.). Geological Survey Professional Paper 424-B. 1961. 352p. (GPO).

One hundred and forty six scientific notes and summaries are presented of investigations by members of the Geologic, Water Resources, and Conservation Divisions of the Geological Survey in the fields of geology, hydrology, and allied sciences. Separate abstracts were prepared for ten of the papers. (M.C.G.)

5573 COFFINITE IN URANIUM VEIN DEPOSITS OF THE FRONT RANGE, COLORADO. P. K. Sims, E. J. Young, and W. N. Sharp. U. S. Geol. Survey. Profess. Papers, No. 424-B, B3-5(1961).

The known occurrences of Coffinite in the Front Range are listed. Coffinite occurs in veins that are characterized by abundant open cavities and conspicuous crustification. It is associated with pitchblende. Quartz is the principal gangue mineral in most deposits. Metallographic studies of the black uranium ores indicated that coffinite formed later than pitchblende. (M.C.G.)

5574 STRUCTURAL CONTROL OF EPIGENETIC URANIUM DEPOSITS IN CARBONATE ROCKS OF NORTHWESTERN NEW MEXICO. Lowell S. Hilpert. U. S. Geol. Survey. Profess. Papers, No. 424-B, B5-8(1961).

The uranium deposits in carbonate rocks in northwestern New Mexico are almost entirely associated with folds, faults, and minor fractures. These deposits are of epigenetic origin; they occur in two geologic provinces in formations of three geologic ages, and they probably represent two different periods of mineralization. It was concluded that localization of the uranium deposits is controlled by the tectonic structures. (M.C.G.)

5575 ORIGIN OF URANIUM AND GOLD IN THE QUARTZ ITE-CONGLOMERATE OF THE SERRA DE JACOBINA, BRAZIL. Max G. White. U. S. Geol. Survey. Profess. Papers, No. 424-B, B8-9(1961).

Fieldwork on the gold and uranium bearing conglomerates at Morios do Vento is reported. The uranium mineral was identified by x-ray diffraction. It occurs in close association with gold and pyrite. A mineralized zone 1,260 m long had an average content of 0.008% equivalent U_3O_8 and 10 g of gold per metric ton of rock. It was concluded that the minerals were emplaced by hydrothermal solutions introduced along a possible north-south fracture or fracture zone. (M.C.G.)

5576 RATIO OF THORIUM TO URANIUM IN SOME PLUTONIC ROCKS OF THE WHITE MOUNTAIN PLUTONIC-VOLCANIC SERIES, NEW HAMPSHIRE. Arthur P. Butler, Jr. U. S. Geol. Survey. Profess. Papers, No. 424-B, B67-9(1961).

The amounts of Th and U and Th/U ratios were found for plutonic rocks of the White Mountain series in New Hampshire. The average values of the Th–U ratio were 3.8 to 4.3. (M.C.G.)

5577 URANIUM AND THORIUM IN THE OLDER PLUTONIC ROCKS OF NEW HAMPSHIRE. John B. Lyons. U. S. Geol. Survey. Profess. Papers, No. 424-B, B69-71(1961).

Chemical and spectrochemical data relating to the distribution of Th and U in three older series of plutonic rocks in New Hampshire are summarized. The Th: U ratio for these rocks was in the expected ranges for calc-alkaline plutons. Much lower ratios for pegmatites compared to Aplites indicated that the two rock types belong to different fractions of the parent magma. Neocrystallization during metamorphism apparently caused a redistribution of U and Th. (M.C.G.)

5578 FREQUENCY CONTENT OF SEISMOGRAMS OF NUCLEAR EXPLOSIONS AND AFTERSHOCKS. S. W. Stewart and W. H. Diment. U. S. Geol. Survey. Profess. Papers, No. 424-B, B243-6(1961).

A technique for calculating the frequency spectrum of relatively small parts of the seismogram and presenting the frequency spectra so calculated as a function of time is discussed. Results are given for calculation by digital methods. The computed frequency spectra were then plotted in the form of a contour map. (M.C.G.)

5579 CLASSIFICATION OF ELEMENTS IN COLORADO PLATEAU URANIUM DEPOSITS AND MULTIPLE STAGES OF MINERALIZATION. A. T. Miesch. U. S. Geol. Survey. Profess. Papers, No. 424-B, B289-91(1961).

Chemical elements in sandstone-type uranium deposits of the Colorado Plateau were classified into two broad groups: dominantly intrinsic elements, or elements whose presence in the deposits is largely unrelated to the process of uranium mineralization, and dominantly extrinsic elements whose presence in the deposits is largely a result of uranium mineralization or related processes. Studies of abundances and distributions of the elements in a typical mining district showed that the amount of each element added to the deposits, except uranium and vanadium, could have come from the altered sandstone. However, the regional distributions of the elements of the Salt Wash member indicated that sources external to the host rock contributed some elements and that at least two periods of mineralization occurred. (M.C.G.)

5580 URANIUM AND RADIUM IN GROUND WATER FROM IGNEOUS TERRANES OF THE PACIFIC NORTHWEST. Franklin B. Barker and Robert C. Scott. U. S. Geol. Survey. Profess. Papers, No. 424-B, B298-9(1961).

Water samples from the igneous terranes of the Pacific Northwest were collected and analyzed for uranium and radium as part of a study of the geochemistry of radioelements. The concentrations of uranium in water from each terrane except the Snake River basalt (which was lower) were in excellent agreement with log-normal distributions. The concentrations of radium in all these terranes were so low that only small portions of the distribution curves were above the detection limit. (M.C.G.)

5581 MEASUREMENT OF BULK DENSITY OF DRILL CORE BY GAMMA-RAY ABSORPTION. Carl M. Bunker and Wendell A. Bradley. U. S. Geol. Survey. Profess. Papers, No. 424-B, B310-13(1961).

A method for determining the bulk density of drill-core samples by gamma absorption is described. Comparative data on a series of samples showed that the gamma absorption method is much faster and has about the same accuracy as fluid immersion methods for determining the bulk density of homogenous core samples. (M.C.G.)

5582 FATIGUE IN SCINTILLATION COUNTING. Francis J. Flanagan. U. S. Geol. Survey. Profess. Papers, No. 424-B, B324-6(1961).

The cause of fatigue in scintillation counting was studied. Experiments indicated that photomultiplier fatigue may be primarily caused by bremsstrahlung resulting from the interaction of beta particles with glass ampoules. (M.C.G.)

5583 GEOLOGICAL SURVEY RESEARCH, 1961. SHORT PAPERS IN THE GEOLOGIC AND HYDROLOGIC SCIENCES, ARTICLES 147-292. (Geological Survey, Washington, D. C.). Geological Survey Professional Paper 424-C. 1961. 406p. (GPO).

Scientific notes and summaries of investigations prepared by members of the Geologic and Water Resource Divisions of the United States Geological Survey in the fields of geology, hydrology and allied sciences are presented. One hundred and forty six papers are included. Separate abstracts were prepared for five papers. (M.C.G.)

5584 PALEOTOPOGRAPHIC CONTROL OF A URANIUM MINERAL BELT, SHIRLEY BASIN, WYOMING. E. N. Harshman. U. S. Geol. Survey. Profess. Papers, No. 424-C, C4-5(1961).

Geologic studies of the Shirley Basin, about 35 miles south of Casper, Wyo., established a relation between the pre-Wind River topography and a mineral belt containing the major uranium deposits. Mineralogic studies of a few high-grade ore samples showed the uranium mineral to be fine-grained uraninite associated with fine-grained pyrite, marcasite, and organic material. A generalized paleotopographic map of the eastern part of the Shirley Basin was prepared. (M.C.G.)

5585 TRITIUM-AGE OF GROUND WATER AT THE NEVADA TEST SITE, NYE COUNTY, NEVADA. Alfred Clebsch, Jr. U. S. Geol. Survey. Profess. Papers, No. 424-C, C122-5(1961).

Tritium in the ground water from the Nevada Test Site and vicinity suggested a much shorter residence time for water in perched aquifers than for water in the main aquifer. Analyses of water samples collected in 1958 and 1959 from a tunnel, a spring, and five wells are reported. The tritium analyses indicated that water in the aquifers tapped by supply wells on the Nevada Test Site and one nearby off-site well had an apparent residence time of more than 50 years. (M.C.G.)

5586 SOME FACTORS AFFECTING THE DETERMINATION OF BERYLLIUM BY THE GAMMA-RAY ACTIVATION METHOD. Wayne Mountjoy and H. H. Lipp. U. S. Geol. Survey. Profess. Papers, No. 424-C, C379-80(1961).

The effects of the size and shape of sample holders on the determination of beryllium by activation analysis were investigated. Half-pint, cylindrical ice cream cartons, shallow cylindrical plastic dishes, and cone shaped dishes were tested. It was concluded from this study that full cartons of sample material, when available for analysis, give reliable results without removing the sample from the half-pint storage container. For smaller amounts of material, the sample should be weighed in one of the plastic holders for the most precise determination of beryllium by this method. The cylindrical holder should be used for amounts over 100 g, but the conical holder should be used if less than that amount is available. (M.C.G.)

5587 DETERMINATION OF BERYLLIUM WITH A DIRECT-READING SPECTROGRAPH. Armin W. Helz and Charles S. Annell. U. S. Geol. Survey. Profess. Papers, No. 424-C, C380-2(1961).

A spectrographic method was developed for determining beryllium quantitatively and rapidly in concentrations ranging from a few parts per million to a few percent in a large variety of silicate rocks and beryllium ores without special attention to the types of samples being analyzed. The spectrograph is a grating spectrograph having a reciprocal linear first-order dispersion of about 5 A per ml and may be used either for photographic or photoelectric recording. The beryllium 3131.07 A line was selected for the analysis. Silicate rock and beryl concentrates, chemically analyzed for beryllium, were used to prepare standards covering a concentration range of 0.00026 to 4.22% beryllium. (M.C.G.)

5588 DENSITY COMPARISON METHOD FOR THE DETERMINATION OF O^{18}/O^{16} RATIOS IN PREPARED WATERS. J. H. McCarthy, Jr., T. S. Lovering, and H. W. Lakin. U. S. Geol. Survey. Profess. Papers, No. 424-C, C387-9(1961).

A method was developed for determination of natural variations in O^{18}/O^{16} ratios by measuring differences in the density of prepared waters of constant hydrogen isotope content. A falling drop comparison method was used for these density measurements. The reproducibility obtained in the range 0 to 8% was $< \pm 0.1\%$ and in the range 16 to 32%, the variation was $< \pm 0.2\%$. Agreement of experimental and known values in the range 0 to 4% was ±0.1%, but above 8% this agreement decreased in a uniform manner. (M.C.G.)

5589 GEOLOGICAL SURVEY RESEARCH, 1961. SHORT PAPERS IN THE GEOLOGIC AND HYDROLOGIC SCIENCES, ARTICLES 293-435. (Geological Survey, Washington, D. C.). Geological Survey Professional Paper 424-D. 1961. 416p. (GPO).

A total of 143 short papers are presented on subjects in the fields of geology, hydrology, and related sciences. Separate abstracts were prepared for 6 of the papers which deal with materials bearing uranium, thorium, and rare earths, underground disposal of radioactive wastes, and tracer techniques. (D.L.C.)

5590 POSSIBLE RELATION BETWEEN HYDROGEN SULFIDE-BEARING HYDROCARBONS IN FAULT-LINE OIL FIELDS AND URANIUM DEPOSITS IN THE SOUTHEAST TEXAS COASTAL PLAIN. D. Hoye Eargle and Alice D. Weeks. U. S. Geol. Survey. Profess. Papers, No. 424-D, D7-9(1961).

The proximity of hydrogen sulfide-bearing oil deposits and uranium deposits in and around Karnes County in Southeastern Texas is pointed out, and it is suggested that the hydrogen sulfide from the oil and gas was the reducing agent which caused the precipitation of the uranium. (D.L.C.)

5591 RESULTS OF INVESTIGATIONS FOR URANIUM IN THE TUCANO BASIN, BAHIA, BRAZIL. D. D. Haynes and J. J. Matzko. U. S. Geol. Survey. Profess. Papers, 424-D, D213-14(1961).

Analyses of splits of 3 samples from the 1626.1- to 1631.0-meter interval of the Petrobras Macaco I well at the town of Jorro in Bahia gave an equivalent-uranium (eU_3O_8) content of 0.083 to 0.096% and a U_3O_8 content of 0.096 to 0.142%. An outcrop of radioactive sandstone was discovered near Poco Redondo (west edge of Tucano basin), ~11 miles southwest of Jorro, and an exploratory hole, Poco Redondo I, was drilled to a depth of 18.5 meters. Selected samples from Poco Redondo I were found to contain as much as 0.20% eU_3O_8 and 0.066% U_3O_8 and to have the same general appearance and mineralogy as the Macaco I samples. (D.L.C.)

5592 THORIUM AND RARE EARTHS IN THE POCOS DE CALDAS ZIRCONIUM DISTRICT, BRAZIL. Helmuth Wedow, Jr. U. S. Geol. Survey. Profess. Papers, No. 424-D, D214-16(1961).

In 1953, an unusual high-grade thorium and rare-earth deposit was discovered at the town of Morro do Ferro, Minas Gerais. A surface exploration program was undertaken to determine the extent of material amenable to openpit mining. Analyses for equivalent thoria ($eThO_2$), total rare-earth oxides, and ThO_2 show that the deposit forms a roughly lenticular zone with a length of ~500 m and a maximum width of ~130 m in which the altered alkalic rocks average ~1% $eThO_2$; the zone is surrounded by a halo several tens of meters broad and of weaker radioactive material (0.1 to 1.0% $eThO_2$). The radioactivity extends to a depth of at least several meters. Assays on unconcentrated material give a range of 0.13 to 3.77% $eThO_2$ and 1.5 to 21.1% total rare-earth oxides. Much of the thorium is present as thorogummite, and the rare-earths occur chiefly in the allanite and bastnaesite. The U content of the samples is low, generally in the 0.00X to 0.0X % range. (D.L.C.)

5593 RADIATION DAMAGE AND ISOTOPIC DISEQUILIBRIA IN SOME URANIUM-BEARING ASPHALTITE NODULES IN BACK-REEF DOLOMITES, CARLSBAD, NEW MEXICO. Arthur P. Pierce and John N. Rosholt, Jr. U. S. Geol. Survey. Profess. Papers, No. 424-D, D320-3 (1961).

Uranium-bearing asphaltite nodules occur in marine carbonate-evaporite rocks of Late Permian age in the Rocky Arroyo area near Carlsbad, N. Mex. The probable geological formation of the asphaltites in the dolomites is discussed. The age of the nodules was calculated to be $203 \pm 20 \times 10^6$ years from the Pb^{206}/U^{238} ratio, $208 \pm 20 \times 10^6$ years from the Pb^{207}/U^{235} ratio, and $270 \pm 65 \times 10^6$ years from the Pb^{207}/Pb^{206} ratio. Possible causes of the age discrepancy were investigated. The fraction of dehydrogenated or crosslinked carbon in the asphaltites was estimated and correlated with possible radioinduced crosslinking. Radiation damage in the form of halos of thermoluminescent dolomite surrounding the nodules indicates that it was caused by beta particles, and uranium and actinium series daughters, except Th^{230}, were found to be impoverished in the nodules but enriched in the halos. The isotopic disequilibria are interpreted in terms of migration. (D.L.C.)

5594 DISPOSAL OF URANIUM-MILL EFFLUENT NEAR GRANTS, NEW MEXICO. S. W. West. U. S. Geol Survey. Profess. Papers, No. 424-D, D376-9(1961).

The possibility of injecting uranium-mill effluent from the Anaconda Co. Bluewater Mill into an unused aquifer below the principal sources of ground water in the area was investigated. A deep test well was drilled to a depth of 2511 ft and injection begun at various rates in the 950- to 1423-ft interval. The results indicate that the effluent can be injected into the lower part of the Yeso formation and that significant vertical leakage into the potable water aquifers is unlikely. (D.L.C.)

5595 THE EFFECT OF FINITE BOUNDARIES ON MEASUREMENT OF GOLD-198 WITH A SCINTILLATION DETECTOR. Bernard J. Frederick and Richard G. Godfrey. U. S. Geol. Survey. Profess. Papers, No. 424-D, D385-7(1961).

In the calibration of equipment for the use of radioactive tracers in open-channel flow studies, the boundary conditions of isotope containment must be considered. Experiments were made which define the effect of boundary conditions on measurements of $Au^{198}Cl_3$ concentration in water in cylindrical tanks of diameters 1, 2, and 4 ft. The results indicate that the effect of proximity to boundaries is minor beyond 12 in., the tank diameter plays a larger role than proximity, and there is an "infinite volume" where observed count rate would not change appreciably with increasing volume. (D.L.C.)

5596 PETROGRAPHY OF RADIOACTIVE TERTIARY IGENOUS ROCKS, FRONT RANGE MINERAL BELT, COLORADO. J. D. Wells (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1032-E. 1960. 54p., 1 illus. (GPO).

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Refer also to abstracts 5177 and 6232

5597 (A/AC.82/G/L.650) RADIOACTIVITY IN PEOPLE LIVING IN THE NORTH OF SWEDEN. Ingvar O. Andersson and Ingvar Nilsson (Aktiebolaget Atomenergi, Stockholm). Nov. 1, 1961. 5p.

Cesium-137 body burdens in people from the village of Masugnsbyn were found to be abnormally high, up to twenty times the average values of people from the Stockholm area. Speculation is given as to the reasons for such high values. The data are tabulated, and a value is given for the normal Cs^{137} body content in the Stockholm area for comparison. (P.C.H.)

5598 (A/AC.82/G/L.655) RESULTS OF SYSTEMATIC MEASUREMENT OF FALL-OUT IN HRADEC KRALOVE AND PLZEN, CZECHOSLOVAKIA. W. Santholzer, V. Havlovic, G. Macku, and J. Podzimek (Karlova Universita, Hradec Králové, Czechoslovakia and Karlova Universita, Pilsen, Czechoslovakia. Lékařské Fakulta). Nov. 1, 1961. 15p.

Fall-out measurements in precipitations for the years 1956 to 1960 in Czechoslovakia showed a similar activity trend to those in Norway. The results of measurements during the period January 1960 to June 1961 showed an increase in activity of rain water in March 1960 after the first French nuclear test on February 13, 1960 that was pronounced but transient. Only small rises in radioactivity were observed for the other tests. Methods of measuring the fall-out are discussed. The results were correlated with meteorological data. (M.C.G.)

5599 (A/AC.82/G/L.696) THE PEAK IN RADIOACTIVE FALLOUT IN THE TEMPERATE ZONE OF THE NORTHERN HEMISPHERE. Y. Miyake, K. Saruhashi, Y. Katsuragi, and T. Kanazawa (Meteorological Research Inst., Tokyo). Aug. 1961. 10p.

It is pointed out that Sr^{90} deposition is much greater in the temperate zone than in the tropical zone with respect to the same amount of precipitation. This means that there is a big difference in the air borne activity between two zones. The concentrated accumulation of radioactive debris is explained by the difference in meteorological conditions in the upper atmosphere above the temperate and tropical regions. In the temperate region extending from 30°N to 60°N, troughs at 500 mb and above are often observed while few troughs appear in the polar and tropical regions. The radioactive dust is brought down near the ground owing to the subsidence of the air in rear of troughs and in the north of jet streams by which acceleration of deposition of radioactive dust in the temperate zone results. (auth)

5600 (APEX-110) SUMMARY HAZARDS REPORT FOR ZERO POWER TESTS WITH THE R-1 MOCKUP REACTOR. E. P. Kerr, ed. (General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati). Oct. 1952. Decl. June 16, 1961. 99p. Contract [AT(11-1)-171].

A proposed test is outlined to verify nuclear characteristics of the first air-cycle aircraft reactor. The program includes experiments on power distribution, rod reactivity, thermal flux traverses, and temperature effects on moderator and fuel elements. The R-1 Mockup Reactor used in the experiments is similar to the design reactor. (J.R.D.)

5601 (APEX-117) FURTHER NUCLEAR ANALYSIS OF Z.P.T. AND L.P.T. REACTOR RUNAWAYS AS REQUESTED BY THE REACTOR SAFEGUARD COMMITTEE. (General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati). Nov. 1952. Decl. June 16, 1961. Contract [AT(11-1)-171]. 32p.

A nuclear analysis of possible runaway in ZPT and LPT reactors is presented. Particular attention is directed to the effects of vaporized fuel element redistribution on reactivity, amount of energy released by reactor implosion-initiated runaway, and comparison of estimated energy release by ZPT and LPT with results of accidental ZPR-1 runaway at Argonne. (J.R.D.)

5602 (APEX-155) SUMMARY HAZARDS REPORT FOR CRITICAL EXPERIMENTS WITH TRA-2 REACTOR. G. P. Kerr, ed. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 2, 1954. Decl. June 9, 1961. 130p. Contract [AT(11-1)-171].

The TRA-2 (Tubular Reactor Assembly), a water moderated reactor using fuel elements composed of 93.4% enriched U as U_3O_8 impregnated Teflon, was designed in order to perform critical experiments to verify the anticipated nuclear and power distribution characteristics of a tubular type aircraft reactor. The core of the TRA-2 is a mockup of the HTRE core. The reactor core is mounted in a hexagonal water tank. Complete descriptions and designs are given for all reactor components. Also included are detailed plans of normal reactor operation, the normal schedule of chemical processing and disposal of reactor products, complete descriptions of safety mechanisms, an analysis of risks and hazards, and the extent of radioactive material and damage to be expected if failure occurs. Included in appendices are lists of the components of the control and safety systems, analyses of the dosage to be expected from radioactive clouds and from cloud rainout, and a discussion of the internal fuse for the TRA-2 reactor. (C.H.)

5603 (APEX-200) SMR SUMMARY HAZARDS REPORT. John N. Renaker, ed. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 15, 1955. Decl. June 16, 1961. Contract [AT(11-1)-171]. 58p.

APEX-206 supplements and covers errata for this report.

The SMR, Solid Moderator Reactor, is a critical assembly designed to predict the characteristics of a direct-cycle aircraft reactor. The design, operation, and potential hazards of this assembly are presented and discussed. (C.H.)

5604 (APEX-254) SUMMARY HAZARDS REPORT FOR CRITICAL EXPERIMENTS WITH TSM REACTOR. J. A. Hoefer, ed. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 10, 1956. Decl. June 9, 1961. Contract [AT(11-1)-171]. 57p.

A critical assembly designed to faithfully mock-up the solid moderator, HTRE-3, direct air cycle reactor is described. The experiment program and operations procedures planned are outlined. The hazards of operating the TSM in Evendale were analyzed and the results set forth in terms of energy and fission fragment release as well as the effect of this release on the test cell and the surrounding area outside Building D. (auth)

5605 (DLCS-3810301) DUQUESNE LIGHT ON-SITE EMERGENCY PLAN DRILL NO. 1, (Major Personal Injury Occurring in the Nuclear Portion of the Station Involving Radioactive Contamination). Test Evaluation. Section 3. R. G. Golias (Duquesne Light Co., Shippingport, Penna.). First issue, Oct. 31, 1961. 16p.

A test was carried out to observe the operation of and evaluate the adequacy of that portion of the On-Site Emergency Plan that applies to a major personal injury occurring in the nuclear portion of the station involving radioactive contamination. The chronology of events as witnessed by participating observers is given. Comments which indicated a need to modify the procedure are listed. It was concluded that additional first aid training is necessary. Changes in procedure resulting from the test are given. (M.C.G.)

5606 (JUL-21-ST) GRUNDLAGEN UND METHODEN DER UMGEBUNGSÜBERWACHUNG UNWELTRADIOAKTIVITÄT DER KERNFORSCHUNGSANLAGE JÜLICH. JAHRESBERICHT 1960. (Fundamentals and Methods of Environs Monitoring. Environmental Radioactivity of the Nuclear Research Installation, Jülich. Annual Report 1960). K. J. Vogt, H. W. Jensen, A. Maas, and R. Tzschaschel (Kernforschungsanlage, Jülich, Germany). Apr. 1961. 165p.

Environs monitoring at the research installation at Jülich is reported. The quantities measured in the monitoring program and the place and frequency of measurements are discussed. Methods and results of monitoring the air, water, soil, plants, and agricultural products are presented. (M.C.G.)

5607 (KAPL-M-HP-10) HEALTH PHYSICS QUARTERLY REPORT, JULY–SEPTEMBER 1961. R. J. Feinberg, comp. (Knolls Atomic Power Lab., Schenectady, N. Y.). Contract W-31-109-Eng-52. 23p.

Routine radiation services are listed. The audit of external and internal radiation exposures revealed no personnel radiation exposure greater than the accepted standard. Environmental radioactivity levels indicated that the operations did not contribute adversely to the background. Radiometric investigations were made to insure that the personnel receiving neutron exposures could be separated from those not exposed. Revisions are being made to parts of the KAPL Nuclear Safety Manual. Emergency services are described for participation in the planned radiation incident drill and the refueling of the S3G at the West Milton Site. Special studies are discussed for assistance given in updating fire fighting procedures, warehousing and material control of radioactive materials, establishing nuclear emergency procedures, evaluation of radiological hazards in critical assembly buildings, and estimating the fission product content of spent fuel for the West Milton Site. (B.O.G.)

5608 (NB-61-349) FINAL SAFEGUARDS REPORT FOR THE NORTHROP REACTOR (NOR). James M. Duncan, Robert D. Thomas, Ben Shimizu, and Earl Feinauer (Norair. Div. of Northrop Corp., Hawthorne, Calif.). Dec. 1, 1961. 224p.

The Northrop Reactor (NOR), consisting of a TRIGA Mark F core, diversified supporting equipment, and specially designed pool and irradiation facilities, will be located at Hawthorne, Calif. The area in which the reactor will be located is completely fenced and guarded. The reactor and facilities will be housed in existing buildings which will be renovated to conform with air-confinement criteria used in the design of other TRIGA Mark F facilities. The reactor is designed for steady-state or pulsed operations. An analysis of reactor safety is presented and it is concluded that the NOR presents no undue hazards to the health and safety of operating personnel or the public. (J.R.D.)

5609 (TID-3570) TRITIUM HANDLING. A Literature Search. William E. Bost, comp. (Division of Technical Information Extension, AEC). Dec. 1961. 23p.

A bibliography is presented consisting of 157 references to literature related to problems and techniques of tritium handling. The subject scope embraces analytical and monitoring procedures and instruments, physiological effects, and safety measures and standards. Summaries of the references may be found in Nuclear Science Abstracts, by means of the NSA reference numbers provided. (B.O.G.)

5610 (TID-5360(Suppl.3)(Rev.)) A SUMMARY OF INDUSTRIAL ACCIDENTS IN USAEC FACILITIES. (Division of Operational Safety, AEC). Dec. 1961. 39p.

The summary includes descriptions of serious accidents for 1959 and 1960, AEC industrial injury frequency rates, criticality accidents, radiation exposures, accidents involving radioactive materials in AEC activities during 1959 and 1960, and accidents involving fatalities in AEC activities during 1959 and 1960. (B.O.G.)

5611 (TID-14424) ENVIRONMENTAL RADIATION MONITORING. Quarterly Report, Third Quarter–1961, July–August–September. (Duquesne Light Co., Shippingport, Penna.). Contract [AT(11-1)-292]. 20p.

A substantial increase in the radioactive content of the fall-out samples and noticeable increases in the activity of the river water samples and the continuous air monitors were observed. The fall-out radioactivity was the highest observed since the second quarter of 1959. The soil, river mud, and vegetation samples were collected before the fall-out increase became apparent and therefore did not reflect this increase. (auth)

5612 (CEA-tr-A-1015) PROCEDES DE DECONTAMINATION. (Decontamination Procedures). H. Stephan. Translated into French from Kerntechnik, 3: 102-5(Mar. 1961). 22p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 17866.

5613 A NEW TECHNIQUE FOR EVALUATING RESPIRATOR PERFORMANCE. William A. Burgess, Leslie Silverman, and Felix Stein (Harvard Univ., Boston). Am. Ind. Hyg. Assoc. J., 22: 422-9(Dec. 1961).

Evaluation of respirators used for protection against dusts, fumes, and mists significantly more toxic than lead, can be conducted utilizing a uranine aerosol with a geometric mean size of 0.20 micron. The uranine aerosol is introduced into an exposure helmet chamber which permits exposure of the subject wearing the respirator to concentrations of below 4 mg/m^3. The aerosol is collected continuously outside the respirator and during inhalation in the respirator void with membrane filters. Uranine analysis by fluorescence permits evaluation of respirator penetration as low as 0.05% in a fifteen minute study with an exposure concentration of 3 mg/m^3. (auth)

5614 MANAGEMENT OF AIRBORNE WASTES IN A NUCLEAR ECONOMY—THE ROLE OF METEOROLOGY. Donald H. Pack (U. S. Weather Bureau, Washington, D. C.). Am. Ind. Hyg. Assoc. J., 22: 471-80(Dec. 1961).

The increasing utilization of nuclear energy will create new types of airborne waste problems. Creation of a neighborhood of multiple reactor sites relatively close together will require airborne budget calculations. In anticipation of these requirements meteorologists are extending their research into larger scales. Some of the new techniques for observation and calculation are presented. Included are radar tracking of tracers to distances of 100 miles, new fluorescent dye experiments, and new wind measuring techniques. (auth)

5615 HEALTH ASPECTS OF THE COMMERCIAL MELTING OF RADIUM CONTAMINATED FERROUS METAL

SCRAP. R. H. Starkey, J. A. Quigley, and J. W. McKelvey (National Lead Co. of Ohio, Cincinnati). Am. Ind. Hyg. Assoc. J., 22: 489-93(Dec. 1961).

Procedures and tests are described whereby it is shown that radium in ferrous metal scrap is virtually all removed in the slag on remelting. The smelting of radium-contaminated ferrous scrap can be performed with safety for the workers by use of proper ventilation and other simple precautions. The purified ferrous metal will not constitute a radiation problem to health from subsequent uses of the metal. (auth)

5616 NUCLEAR ATTACK AND INDUSTRIAL SURVIVAL. Electronics, 35: No. 2, S1-S16(Jan. 12, 1962).

The problems of U. S. industrial survival and recovery from nuclear attack are discussed and methods of protection are described. The effects of an atomic attack are shown both graphically and tabularly. These effects are divided into blast and thermal effects and areas affected by fall-out. The effectiveness of fall-out shelters is shown for both military and civilian targets. The organization necessary for setting up a survival plan is also outlined along with the preparations that can be made for post-attack recovery. (N.W.R.)

5617 THE POSSIBILITY OF USING CERTAIN ORGANIC SCINTILLATORS FOR DOSIMETRY. Yu. A. Egorov and V. A. Kucheryaev. Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 7, 117-19(July 1961). (In Russian)

The scintillators investigated are similar in composition to biological tissue. The dependence of the fast neutron absorption dose rate on neutron energy for these scintillators is similar to Snyder's curve for biological tissue. The results of investigations show that both the plastic and liquid scintillators can be used for fast neutron dosimetry. The dependence of the sensitivity of both scintillators on γ radiation energy is approximately the same as that of air-filled aluminium-wall ionization chamber. (auth)

5618 RADIOACTIVE GASEOUS WASTES AND PROTECTION OF THE ENVIRONMENT. H. Karwat. Kerntechnik, 3: 487-91(Nov. 1961). (In German)

Measures taken at German nuclear facilities to insure against air and water contamination by gaseous radioactive wastes are described. (N.W.R.)

5619 DETERMINATION OF THE STRESS CAUSED BY FAST NEUTRONS WITH THE AID OF NUCLEAR TRACE FILMS DURING ROUTINE PERSONNEL CHECKS. Hans Dresel (Universität, Freiburg i. B.). Kerntechnik, 3: 498-500(Nov. 1961). (In German)

Special nuclear trace films are used for the detection of fast neutron doses. The accuracy of this procedure, where the protons released by the fast neutrons are counted in the emulsion, is very unsatisfactory. Measuring the length of the traces would be too time-consuming for routine checks. The number per area unit of the microscopically detected proton traces is therefore largely dependent on the respective neutron energy if the quantity of incident neutrons (n/cm^2) remains constant. The two most commonly used films are investigated as to their respective behavior in various energy spectra. It is found that there are no significant differences between the two types in the energy range 0.5 to 14 Mev. In both types, a maximum of 19 to 21% of the 14 Mev neutrons is counted if a 100% count (comparative film calibrated with Po-Be) is used as a basis for the spectrum of a Po-Be neutron source. (auth)

5620 ANALYSIS OF THE RELATIONSHIP BETWEEN DEPOSITION OF LONG-LIVED FISSION PRODUCTS AND LEVEL OF ACTIVITY IN MILK. W. Anderson, L. K. Burton, and J. O. Crookall (Royal Cancer Hospital, London). Nature, 192: 1009-12(Dec. 16, 1961).

Data are presented on levels of Sr^{90} and Cs^{137} occurring in milk produced in west Cardiganshire, Wales, throughout 1960. The data are examined in relation to data on samples collected during 1958 and 1959. The extent to which levels of radioactivity in milk may be influenced by winter and summer feeding conditions and the reservoir of activity accumulated in the top layer of soil are discussed. (C.H.)

5621 RADIATION AND THE HUMAN BODY. S. Schmidt. Nuclear Energy, 378-81(Sept. 1961).

The potential dangers and harmful effects of radiation are illustrated, and the importance of collaboration between industry, the medical profession, biologists, and physicists is stressed. Emphasis is on the importance of objective decisions, regardless of political or economic considerations, when health problems concerning nuclear energy are under examination. (N.W.R.)

5622 A PROTECTIVE TABLE FOR WORKING WITH RADIOACTIVE PREPARATIONS. A. A. Stankevich (Inst. of Oncology, Academy of Medical Science, Leningrad). Problems of Oncol. (U.S.S.R.) (English Translation), 7: 460-3 (Nov. 1961).

Design features are presented for a protective manipulating table for use when administering and implanting radioactive preparations to patients. The table was designed for working with closed radioactive preparations with a total activity of up to 250 milliequivalents of radium. (C.H.)

5623 CERIUM-144 IN FOOD. N. Nezu, M. Asano, and S. Ouchi (Ibaraki Prefectural Inst. of Health, Ibaraki, Japan). Science, 135: 102-3(Jan. 12, 1962).

Small amounts of cerium-144 were found in samples of food and animal bone obtained from Ibaraki, Japan. The highest level of radioactivity was detected in clams harvested from Hinuma Marsh. In view of the widespread occurrence of cerium-144 in tested samples, it is assumed that the presence of this radionuclide is due to fall-out. (auth)

5624 IMPROVEMENTS IN OR RELATING TO POWDERS FOR EXTINGUISHING FIRES. Lawrence Henry Cope (to Unived Kingdom Atomic Energy Authority). British Patent 884,946. Dec. 20, 1961.

Powders suitable for extinguishing fires of burning uranium, plutonium, or thorium metal comprise mixtures of inorganic chloride and/or fluoride salts which are inert toward such burning metals and which have melting points below 640°C. The salts usually are of the alkali metals and alkaline earth metals. In use, the powder is dumped over the burning metal to form a cone; the frit so formed excludes the air, and heat is absorbed by the fusing of the powder. (D.L.C.)

5625 IMPROVEMENTS IN AND RELATING TO BOMBSHELTERS. Morton M. Rosenfeld. British Patent 885,259. Dec. 20, 1961.

A bombshelter for individual homes is designed which is relatively cheap to build and provides some protection against the radioactivity and heat of a nuclear bomb explosion. It is made out of reinforced concrete and has two entrances, one leading outside and the other leading to the basement. It has barriers against flooding should a pipe burst in the basement and against gamma radiation should either door be left open or damaged. (D.L.C.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

5626 (NYO-9699) PHASE I REPORT OF DEVELOPMENT TECHNIQUES FOR POWER PRODUCTION FROM MIXED FISSION PRODUCTS. D. Eaton (General Instrument Corp., Newark, N. J.). Feb. 18, 1961. Contract AT(30-1)-2605. 120p.

An investigation was made into the various processes for the fixation of mixed fission products as solids in order to determine the extent they could be utilized as heat sources for thermoelectric generators. Generators of up to ten watts can be designed and built with "state-of-art" thermoelectric materials and mixed fission products soon to be available from the Idaho Falls calcination pilot plant. Mixed fission products from other processes and plants to be "on stream" in this decade will be capable of fueling practical generators into the kilowatt range using thermoelectric materials available in the same time period. A survey was made on current research and development efforts on waste fixation processes. Studies showed that a wide range of power densities (from 0.002 to 0.2 watts per cubic centimeter) will be available from calcined fission product wasted. An experimental program for the consolidation of low density, Idaho Chemical Processing Plant alumina type wastes is reviewed. Preliminary results indicated that densification factors of three to four are readily obtainable for such wastes. Bulk densities of 0.8 g/cc were increased to 2.9 g/cc by selective use of fluxes and cold compacting techniques. This means that power densities of up to .001 w/cc will be possible from waste materials in the Idaho Chemical Processing Plant tanks. An experimental program for the evaluation of the high temperature life characteristics of bismuth telluride alloys is discussed. A program for the optimization of thermoelectric convertor design utilizing the diffuse heat from a mixed fission product source is described, derivation of pertinent equations are presented and results of the study are discussed. Conceptual designs for thermoelectric generators utilizing diffuse fission product heat sources are described. Problem areas regarding the use of mixed fission products in conceptual thermoelectric conversion device designs are discussed, with particular emphasis being placed on underwater applications. In view of these recent technological developments regarding the power reactor program and waste disposal utilization of calcined wastes such as the Idaho Chemical Processing Plant high level waste stream now appears very attractive. With power densities of 0.0002 watts per cubic centimeter available now, and increases by factors of 50 to 1000 likely within the near future, thermoelectric power generators of 3 to 300 watts are within the realm of present day design and fabrication techniques. Higher power levels, up to kilowatts will be available with the inevitable increase in thermoelectric material efficiency. (auth)

5627 LEAK DETECTION USING Kr^{85}. P. F. Berry and J. F. Cameron (Wantage Research Lab., Berks, Eng.). Intern. J. Appl. Radiation and Isotopes, 12: 69(Nov. 1961). (In English)

Some aspects of the use of krypton-85 for detecting leaks in hermetically sealed vessels are described. Pressures up to 100 psi are achieved by transferring the krypton-85 from a 4 liter reservoir to a 0.5 liter pressure vessel. Transfer is accomplished by means of a charcoal trap onto which the gas is first frozen with liquid nitrogen and then boiled off using a small furnace, appropriate taps being manipulated to direct the flow of gas. The detection efficiency for krypton-85 forced into a vessel depends on the dimensions and material of the vessel, and a large proportion of the radiation is Bremsstrahlung. With an average detection efficiency of about 1%, a leak rate of 10^{-10} standard ml/sec into the encapsulation at the test pressure will give a count of 5/sec after 1 hr in maximum specific activity gas (50 mc/standard ml). This is readily detectable above the background of 6 counts/sec in a monitoring time of 10 sec. (N.W.R.)

5628 APPLICATION, ECONOMICS AND CHOICE OF RADIATION SOURCES. H. D. Heinze and E.-G. Hofmann (Badische Anilin- und Soda-Fabrik A. G., Ludwigshafen, Ger. and Allgemeine Elektricitäts-Gesellschaft, Berlin). Kerntechnik, 3: 475-82(Nov. 1961). (In German)

In regard to the main field of applications of high-energy radiations (chemistry, biology, pharmaceutics, and food industries), the properties of radiation sources available today are subjected to closer examination from a technical and economic standpoint. Electron accelerators, high-power x-ray equipment, and Co^{60} sources of different capacity are discussed in detail whereas the remaining radiation sources, such as fission products, spent fuel elements, and reactors are only briefly mentioned. It is also shown that the choice of a radiation source must not be based on merely economic but on technical considerations also. (auth)

5629 RADIOACTIVE TRACER DETERMINATION OF THE DISCHARGE AND RATE OF MOVEMENT OF WATER IN POROUS MEDIA. M. P. Volarovich, N. I. Il'in, and N. V. Churaev (Kalinin Peat Inst., USSR). Kolloid. Zhur., 23: 524-7(Sept.-Oct. 1961). (In Russian)

A procedure was developed for testing methods of measuring the discharge of water in porous media by means of radio-tracer techniques, using sand and peat as specimens. An expression was deduced based on measurements of the passage of the indicator through the test workings. Experimental test showed the relative error of measurement to be less than 4 to 6%. (auth)

5630 RADIOTRACER METHOD OF DETERMINING THE ADSORPTIVE CAPACITY AND SPECIFIC SURFACE AREA OF PHOSPHATE COATINGS. V. S. Lapatukhin and Yu. M. Ovchinnikov (Scientific Research Inst., Polygraphic Industry, Moscow). Kolloid. Zhur., 23: 592-5(Sept.-Oct. 1961). (In Russian)

The adsorption of fatty acids by phosphate films on metals from non-polar solutions is investigated with the aid of carbon C^{14}–labeled tridecylic acid. The method permits the simultaneous determination of the specific surface area of the phosphate coatings. (auth)

5631 INTRODUCTION OF Au^{198} INTO THE ANODE OXIDE FILM ON ALUMINUM. A. F. Bogoyavlenskii and N. K Matyazh (Kazan Aviation Inst.). Zhur. Priklad. Khim., 34: 1892-3(Aug. 1961). (In Russian)

Introduction of Au^{198} into the anode oxide film forming on aluminum is described. The feasibility of diffusing ion admixtures into anode oxide films at certain conditions is confirmed. (R.V.J.)

ISOTOPE SEPARATION

5632 (CEA-tr-X-283) PROCÉDÉ POUR LA CONCENTRATION DE L'EAU LOURDE PENDANT L'ÉLECTROLYSE D'EAU. (Process for Concentration of Heavy Water during Electrolysis of Water). A. E. Knowles. Translated into French from Dutch Patent 42,704. 1938. 7p.

A procedure is given for the concentration of heavy water in the successive electrolysis stages of water. In the procedure the vapor entrained by the gas in each electrolytic cell or group of cells is condensed before the gas is purified, and the concentration product is used for the feed of the next cell or group of cells. The amount of vapor which leaves the cells at different stages is controlled by the temperature of the cells. The gas leaving the cells at each stage, after being cooled, is washed for the condensation of the vapor with the water which is added at this stage. (tr-auth)

5633 (CEA-tr-X-349) CENTRIFUGEUSE DE GAZ. (Gas Centrifuge). N. E. Bergner. Translated into French from Swedish Patent 124,732, Apr. 26, 1949. 30p.

The design and properties of a gas centrifuge are described in which the gas is introduced into the external part of the separation chamber in such a manner as to produce a rotating movement around the central axis of the chamber, to cross the chamber by increasing its angular velocity, and to be diverted in the central part of the chamber. This central part is characterized by the presence of a turning helix in the form of an endless screw having one or several outlets to extract from the separation chamber the particles in suspension in the gas to be centrifuged. The helix turns in the same direction as the gas and has an angle of inclination less than 45°. The length of the helix is equal to or greater than its largest dimension and is greater than the dimension of the gas inlet. The turning velocity of the helix and its dimensions, the outlet dimensions, and inlet properties are given. (J.S.R.)

5634 SEPARATION IN A CENTRIFUGE-MODEL. J. Strnad (Univ. of Ljubljana, Yugoslavia). Appl. Sci. Research, 10A: 307-10(1961). (In English)

The maximum peripheral velocity for a cylindrical centrifuge, where gas motion need not be considered, is analyzed mathematically. (P.C.H.)

5635 THE EQUILIBRIUM DISTRIBUTION OF TRITIUM IN HYDROGEN ISOTOPE EXCHANGE. Ya. M. Varshavskii and S. E. Vaisberg (Inst. of Radiation and Physico-Chemical Biology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 140: 1361-3(Oct. 21, 1961). (In Russian)

The distribution coefficient α for proton-tritium exchange cannot be calculated in many cases because of the lack of data on the vibrational and rotational frequencies of the tritium-containing compounds. However, an approximate value of α can be obtained from a knowledge of the β-factor which is determined by the number of external electrons and by the number of completed electron shells in the element. Thus, the β-factors of CH_4, NH_3 and H_2O and also of other compounds containing CH-, NH- and OH-groups can be set equal to the β-factor of HF. The β-factor of BH_3 and of other boron hydrides can be set equal to the β-factor of the NH radical (6 external electrons). The β-factors of SiH_4, PH_3 and H_2S are close to that of HCl. The β-factors for tritium-proton exchange can readily be calculated by using the observed oscillation frequencies of a monovalent hydride and the oscillation frequency of the corresponding tritide which is obtained from the ratio of the reduced masses of the tritide (μ_T) and of the hydride (μ_H): $\nu_T = \nu_H \sqrt{\mu_T/\mu_H}$. The distribution coefficients of tritium ($\alpha = \beta_1/\beta_2$) at 20°C are given for any pair of the following, hydrogen-containing compounds: H_2, CH_4, NH_3, H_2O, HF, PH_3, H_2S, HCl, HBr, HI, LiH, NaH, KH, RbH and CsH. The β-factor of water calculated from the oscillation frequencies of H_2O and T_2O is 31.6 at 20°C, and this value is close to the β-factor of HF which is 27.4. (TTT)

5636 FUNDAMENTAL STUDIES ON THE ION EXCHANGE SEPARATION OF ISOTOPES. IV. SEPARATION FACTOR OF LITHIUM ISOTOPES USING ION EXCHANGER. Hidetake Kakihana, Terunosuke Nomura, and Yoshihiro Mori (Tokyo Inst. of Tech.). J. At. Energy Soc. Japan, 3: 849-54(Nov. 1961). (In Japanese)

The ion exchange separation factors of lithium isotopes in LiCl and LiOH solutions were determined with differently cross-linked sulfonated styrene-divinylbenzene copolymers and a synthetic inorganic ion exchanger, Ionite C, (zirconium phosphate type). The isotopic ratios of lithium were measured by a mass spectrometer using the thermionic method. The highest separation factor, 1.022, was obtained for the system of 0.1m LiOH in 20% acetone-H_2O mixture using Ionite C. From experimental data, the equilibrium constant of the following isotope exchange reaction in solution was estimated tentatively as 1.04; $Li^{7+} + Li^6OH \rightleftharpoons Li^{6+} + Li^7OH$. Synthetic inorganic ion exchanger, Ionite C, gave higher separation factors than the organic ones. This fact can be explained by the following isotope exchange reaction in the exchanger phase: $Li^7{}_E + ELi^6 \rightleftharpoons Li^6{}_E + ELi^7$ and its equilibrium constant of 0.992. The highly cross-linked ion exchange resins and the addition of ethanol or acetone were also effective to obtain the higher separation factors. (auth)

5637 ON THE ISOTOPE SEPARATION BY COUNTERCURRENT GAS CENTRIFUGE. I. INFLUENCE OF A GAS FLOW PATTERN UPON SEPARATIVE POWER. Akira Kanagawa and Yoshitoshi Oyama (Tokyo Inst. of Tech.). J. At. Energy Soc. Japan, 3: 868-73(Nov. 1961). (In Japanese)

The influence of a gas flow pattern in a rotor of a countercurrent gas centrifuge upon the separation factor and the separative power is studied. The optimum gas concentration gradient, at which the centrifuge has maximum separative power, is obtained from the equation of the diffusion velocity. The equations with respect to the separation properties are derived in two regions of the rotor separately, one of which is an upper part above the feed point as a stripping section, the other a lower part as an enriching section. The effects of the radial concentration gradient on the performance of the centrifuge are considered by means of the flow pattern coefficient K, which depends only upon the flow pattern and approaches the maximum value, unity, as the neutral layer between the counter currents approaches the rotor wall. (auth)

5638 PURIFICATION OF HYDROGEN ISOTOPES BY SELF-DISPLACEMENT CHROMATOGRAPHY AT LOW TEMPERATURES. T. R. Phillips, D. R. Owens, and A. G. Hamlin (United Kingdom Atomic Energy Authority, Capenhurst, Ches., Eng.). Nature, 192: 1067-8(Dec. 16, 1961).

A procedure is described for the separation of hydrogen isotopes by means of a column containing molecular Sieve 5A initially at liquid-nitrogen temperature. The adsorptive capacity of the Sieve is 43.5 ml of protium/gm and 47.5 ml/of deuterium/gm. A laboratory-scale apparatus may be readily constructed which is capable of purifying several liters of hydrogen isotope mixture per hour. (C.H.)

5639 EFFECT OF THE SURFACE DIFFUSION ON THE SEPARATION EFFICIENCY. K. Ishida, J. Shimokawa, and Y. Yamamoto (Atomic Energy Research Inst., Japan). Trans. Faraday Soc., 57: 2018-26(Nov. 1961).

Flow equations for each component of a binary gas mixture were obtained by the addition of surface diffusion terms to Present-deBethune's flow equations. The separation efficiency derived from these flow equations is represented as a product of Present-deBethune's formula and a correction factor, which includes the correction factor defined by Massignon as a special case. The effects of surface diffusion on the flow equations and on the separation efficiency are investigated in some detail. (auth)

5640 VYDELENIE DEITERIYA IZ VODORODA METODOM GLUBOKOGO OKHLAZHDENIYA. (Separation of Deuterium from Hydrogen by Deep Cooling Method). M. P. Malkov, A. G. Zel'dovich, A. B. Fradkov, and I. B. Danilov. Moscow, Gos Atomizadt, 1961. 114p.

The physical and technological aspects of deuterium separation by deep cooling are analyzed. Data are given on specific liquid H fractionation and on the liquifying method. The physical and chemical constants of hydrogen isotopes are organized in a convenient way. The book is suggested for personnel working with heavy water and for engineers and technicians interested in deep cooling and isotopic separation. (R.V.J.)

5641 ISOTOPE SEPARATOR. R. J. L. Gassot. Addition 74,730 to French Patent 1,203,343. Jan. 16, 1961.

An electrolytic process with several anodes of a radioactive material arranged in a circle and one cathode at the center is described. Radioactivity which is concentrated near the cathode furnishes heat. The whole apparatus can be rotated. (NPO)

5642 GAS CENTRIFUGE FOR THE PURPOSE OF ISOTOPE ENRICHMENT. (to Licentia Patent-Verwaltungs G.m.b.H.). French Patent 1,215,694. Nov. 23, 1959.

In a cylindrical vessel of short axial length, a magnetic field is applied parallel to the axis and an arc discharge is maintained between the cylindrical wall and central electrodes near the end planes of the cylinder. If the pressure of the gas in the vessel is such that the collision frequency of the ions is more than twice the rotation frequency of the ions in the magnetic field, and the radius of the vessel is larger than the radius of the rotation circle of an ion, a rotation of gas will take place in the vessel. This causes isotope enrichment at the center and at the periphery of the vessel. (NPO)

MATHEMATICS AND COMPUTERS

Refer also to abstract 5461

5643 (DANATOM-05-61) DARE—A CODE FOR COMPUTATION OF THE STEAM REACTIVITY IN A DUAL CYCLE BOILING WATER REACTOR WITH FORCED CIRCULATION. (Danish Assn. for Industrial Development of Atomic Energy, Hellerup). Dec. 1961. 31p.

A code for the calculation of steam reactivity, power, steam quality at the outlet from the core, subcooling of recirculation water at the inlet to the core, and secondary steam pressure for a dual cycle boiling water reactor with forced circulation is described. The quantities in question can be determined for various values of primary and secondary steam flow, and the results may be used directly for plotting a complete performance diagram. The code was written for use in design studies; for this reason the reactivity calculation was made on the basis of the one group theory, and certain simplifications, in addition, were introduced in the calculations. The computation on DASK, a Danish digital computer, of the above five quantities for a certain set of values of primary and secondary steam quantities lasts about 7 seconds inclusive of the punching of the results on paper tape. (auth)

5644 (GA-2525) A PROGRAM FOR THE CALCULATION OF RESONANCE INTEGRALS. G. F. Kuncir (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 28, 1961. Contract AT(04-3)-167. 152p.

A computer program was developed to calculate resonance integrals from resonance parameters for a wide variety of temperatures, compositions, and geometries. The resonance integral calculation is in two parts. The resolved resonances are treated by the computer program ZUT and the unresolved resonances by the program TUZ. Each program was written in a combination of the FORTRAN and FAP source program languages for the IBM-7090 Data Processing System. (M.C.G.)

5645 (HW-70049) THE RBU REACTOR-BURNUP CODE: FORMULATION AND OPERATING PROCEDURES. J. R. Triplett, E. T. Merrill, and J. R. Burr (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1961. Contract AT(45-1)-1350. 195p.

RBU is a digital program for the detailed calculation of the neutron, reactivity, and isotopic history of a reactor in which relatively exact models of the geometry and physical processes are included to permit reliable predictions of fuel costs and reactor performance. The program uses the Monte Carlo method to obtain the fine structure of the neutron flux in three space dimensions and energy. Using this fine structure, cross sections are averaged over space and energy to obtain the characteristics of equivalent homogeneous one-dimensional regions of space and ranges of energy. These are used in diffusion calculations to obtain the macroscopic flux distribution throughout the reactor. The consumption and production of isotopes is computed for a time step by the solution of sets of partial differential equations involving both the macroscopic and microscopic fluxes. With the new concentrations, diffusion calculations are performed again to obtain macroscopic fluxes for the next time step. At variable intervals, Monte Carlo calculations are again performed to determine the changes in microscopic flux distributions. The cycle is repeated until conditions of the reactivity or other properties dictate the end of the calculation. Programmed control rod manipulation may be included in the calculation. The Monte Carlo, diffusion, or burnup portions of the program may be used separately. The unresolved resonance range is treated by random selection of resonance parameters from appropriate distributions using the Doppler-broadened, single level Breit-Wigner formula. Resolved resonances are treated similarly with the exception that specific values of the resonance parameters are used. The effects of molecular binding and thermal motion of the nuclei on near-thermal scattering are treated by a simple model capable of incorporating the pertinent physical theory and data. (auth)

5646 (KAPL-M-EC-13) DICECT—A COMPUTER PROGRAM TO REDUCE CORE EXIT COOLANT TEMPERATURE DATA. E. F. Adiutori and J. A. Warrington (Knolls Atomic Power Lab., Schenectady, N. Y.). June 6, 1961. Contract [W-31-109-Eng-52]. 17p.

DICECT is a digital computer program which processes thermocouple readings of core exit coolant temperatures. The thermocouples are arranged in small groups throughout the reactor. The primary purpose of this program is to analyze the variance within each group. A secondary function of the program is to determine the statistical variance when the data are corrected for deviations from standard measurements on fuel loading and channel dimensions. The approximate running time is one minute per case. (auth)

5647 (KAPL-M-EC-14) LINER–A STATISTICAL DATA REDUCTION COMPUTER PROGRAM FOR THE PHILCO 2000 COMPUTER. J. A. Archibald, Jr. and A. Tedesco (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 28, 1961. Contract W-31-109-Eng-52. 37p.

LINER applies a weighted least squares procedure to fit a linear regression to sets of data where each set is obtained at a different value of an independent variable, x. Estimates and prescribed level confidence limits for the slope and intercept of a line of the form: $y = mx + b$, representing these data are obtained. The method of solution is based on an analysis developed by M. Halperin. The input consists of a set of controlled constants and the raw data. The limitations of the program are: $I \leqq 30$, where I = number of values of the independent variable, and $I < J \leqq 50$, where J = number of readings of data points. The approximate running time is 3 minutes for a typical problem. (auth)

5648 (LAMS-2539(Suppl.)) EQUATIONS REPRESENTING REACTOR SYSTEM WITH EMPHASIS ON KIB DIGITAL PROGRAM. R. R. Mohler (Los Alamos Scientific Lab., N. Mex.). Aug. 29, 1961. Contract [W-7405-Eng-36]. 16p.

Equations for use on the KIB digital program for rocket reactor calculations are given. Equations are included for calculation of steady state variables from thrust, steady state reactor power and propellant temperatures, power generation profile, transfer functions of temperatures, perturbations, reactivities, and actuator dynamics. (M.C.G.)

5649 (WAPD-TM-252) XACT—A BUFFERED TAPE READ-WRITE SUBROUTINE FOR THE PHILCO-2000. W. H. Guilinger (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1961. Contract AT-11-1-GEN-14. 48p.

The subroutine, XACT, relieves the programmer of many details involved in the use of magnetic tapes on the Philco-2000. Parity and sprocket errors are corrected automatically in both reading and writing, and in the case of forward reads, other errors will be corrected automatically. If a write ring is not inserted on a tape to be written, or if a tape is in local, the operator is informed of the situation via the flexowriter, and after corrective action has been taken, hitting advance will allow the program to resume. There is no limitation on the number of tapes "in use" by XACT simultaneously, and whatever assemblers are available will be used. When the assembler interrupt becomes available, it will require only minor changes in XACT to utilize it efficiently. (auth)

5650 ANALYTICITY OF WIGHTMAN FUNCTIONS. Christian Fronsdal (Univ. of Pennsylvania, Philadelphia). J. Math. Phys., 2: 748-58(Nov.-Dec. 1961).

The problem of mapping certain domains in the space of complex four-vectors onto the space of their inner products is solved. The "primitive" domains of regularity of the three and four point Wightman functions are determined. The domains whose X-space characterization was obtained by Streater, for the holomorphy envelope of the union of several primitive domains (both for the three- and four-point function) are also determined. The corresponding problem in perturbation theory is examined, and the analytic form of the perturbation theory boundary of the three- and four-point functions is obtained by the same method. The problem of the four-point function is reduced to constructing the holomorphy envelope of the union of three domains. It is shown that the boundary of the domain of four-point singularities in perturbation theory bears no resemblance to any part of the boundary of the primitive domains, or the domains found or conjectured by Streater. (auth)

5651 ON THE EVALUATION OF THE FUNCTION $\phi(\lambda) = (1/2\pi i)\int_{\sigma-i\infty}^{\sigma+i\infty} e^{u \ln u + \lambda u} du$ FOR REAL VALUES OF λ. Wolfgang Boersch-Supan (Naval Research Lab., Washington, D. C.). J. Research Natl. Bur. Standards, 65B: 245-50 (Oct.-Dec. 1961).

The evaluation of the function is done by deriving asymptotic formulas with error terms for the large values of $|\lambda|$. For values of λ in the remaining finite interval, Simpson's rule is applied after suitable transformation of the path of integration and restriction to a finite portion of this path. A table of the function is given together with guesses of the errors due to the discretization and the finite integration limits. (auth)

5652 FUELCYC, A NEW COMPUTER CODE FOR FUEL CYCLE ANALYSIS. PART I. COMPUTATIONAL MODEL. Raymond T. Shanstrom and Manson Benedict (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 11: 377-85(Dec. 1961).

FUELCYC is a code, written in the Fortran II language for a 32,000-word IBM 704 computer, which has been developed for the study of fuel cycles in large cylindrical thermal power reactors. It is a two-dimensional diffusion-theory code in which it is assumed that the reactor core is symmetrical in the azimuthal direction. Core properties such as the fuel composition, burnup, flux and power-density distributions, and reactivity can be calculated throughout the life history of the fuel for different methods of managing fuel and control poisons. Only a few minutes of computer time are required for a complete fuel-cycle analysis of the life history of the core. (auth)

5653 FUELCYC, A NEW COMPUTER CODE FOR FUEL CYCLE ANALYSIS. PART II. EXAMPLES OF APPLICATIONS. Manson Benedict, Raymond T. Shanstrom, Stanley L. Amberg, N. Barrie McLeod, and Paul T. Steranka (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 11: 386-96(Dec. 1961).

Examples are given of the application of computer code FUELCYC to fuel cycle analysis of pressurized water, organic moderated, and heavy water reactors. Properties of these reactors evaluated include the flux energy spectrum, changes in fuel composition and effective cross sections on irradiation, and changes in power density distribution. The effects of different initial fuel enrichments and six different fuel and poison management procedures on the average burnup of fuel, its maximum burnup, the peak-to-average power density ratio, and fuel cycle costs are investigated. Fuel cycle costs may be reduced by having good neutron economy, high burnup, and a steady fueling procedure in which neutrons are not wasted in control poison. Of the fueling methods examined, out-in fueling, or some discontinuous approximation to it, seems best because of its flat power-density distribution and relatively low fuel cycle cost. Where mechanically feasible, bidirectional axial fueling is also advantageous because of the uniform fuel burnup it makes possible and its low fuel cycle cost. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

5654 (APEX-307) DEVELOPMENT STUDY OF CLAD HYDRIDED ZIRCONIUM AS SOLID MODERATOR. Coy L. Huffine (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 6, 1956. Decl. June 9, 1961. Contracts AF33(038)-21102 and AT(11-1)-171. 35p.

A summary of the knowledge on the use of clad hydrided zirconium as a solid moderator up to January 1956 is presented. Physical property data are compiled, and information in regard to cladding and evaluation testing of clad sections is summarized. The discussion, in regard to cladding, is generalized so that the data presented are not limited to one design. (P.C.H.)

5655 (NEPA-947) COMPOUNDS OF LIGHT ELEMENTS FOR USE AS MODERATORS. M. E. Lee (Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn.). Apr. 11, 1949. Decl. July 18, 1961. 42p. Contract [W-33-08-ac-14801(16250)].

Data from the literature is presented concerning the physical and chemical properties of alloys and systems composed of two or more of the elements Al, Be, C, N, O, F, and Mg. Methods of synthesis are also surveyed in a program to find materials for use as moderators in high-temperature reactors. (J.R.D.)

5656 (NMI-2099) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for September 1961. (Nuclear Metals; Inc., Concord, Mass.). Dec. 14, 1961. Contract AT(30-1)-1565. 13p.

Progress is reported on developments in studies on the high-temperature properties of refractory metal alloys, the corrosion of zirconium alloys, irradiation behavior of metastable beta-phase uranium, and the fundamentals of single crystal deformation in zone-refined beryllium. (B.O.G.)

5657 (TID-14423) THE PREPARATION AND STABILITY OF CARRIER-FREE AMALGAMS. Annual Report, June 1960—July 1961. Milton Kahn and H. L. Hamester (Sandia Corp., Albuquerque, N. Mex.). Contract [AT(29-1)-789]. 49p. (SCDC-2516)

Results of investigations concerning the preparation and properties of amalgams of 10.6-hour carrier-free Pb^{212}, and the radiocolloidal and adsorptive properties of carrier-free Ag^{110} are reported. Data and discussion related to recovery of Pb^{212} activity from active acetic acid-hydroxylamine hydrochloride—potassium bitartrate electrolyte are presented along with similar information on stability and homogeneity of Pb^{212}—Hg amalgams. In work on Ag^{110}, the rate of carrier-free Ag adsorption by glass, teflon, polyethylene, and precipitates, and the formation rate of carrier-free radiocolloids was initiated. Data are included on Ag adsorption from nitric acid solutions on pyrex at 31.8°C as a function of reagent concentration and time. Also included are data on adsorption of glass from water, ammonium hydroxide, and sodium carbonate, and from perchloric, hydrochloric, acetic, and sulfuric acid solutions. (J.R.D.)

5658 (CEA-tr-X-290) METHODE DE REVETEMENT ELECTROLYTIQUE DU ZIRCONIUM. (Method of Electrolytic Deposition of Zirconium). Koizumi, Huagawa, Adachi, and Kobayashi. Translated from Japanese Patent 172,312. June 22, 1946. 4p.

A method for the electrolytic deposition of zirconium on metallic cathodes by electrolysis in the presence of halogen ions of a solution of a complex zirconium salt and of an organic acid such as salicilic or oxalic acid is presented. (J.S.R.)

5659 (CEA-tr-X-421) MÉTHODE DE FABRICATION DE POUDRES DE NICKEL DE TRÈS HAUTE PURETÉ. (Method of Production of Nickel Powders of Very High Purity). J. Kaloc and V. Dlouhy. Translated into French from Czech. Patent 88,292. Jan. 1956. 5p.

A method is given for the fabrication of nickel powder of very high purity. The method is characterized by the fact that the solution of the nickel salt is electrolyzed directly in an acid or alkaline solution using a mercury cathode. The amalgam formed is exposed to a thermal treatment in order to eliminate the mercury. (tr-auth)

5660 NON-FERROUS METALS AS CONSTRUCTION MATERIALS IN A REACTOR. [PART] I. E. Gebhardt (Max-Planck-Institut für Metallforschung, Stuttgart). Atomwirtschaft, 6: 447-8(Sept. 1961). (In German)

Because of the multiplicity of required characteristics, the choice of reactor materials must be a compromise in which optimum fitness for a specific case must be inferred from experience and "know-how". The present report gives a general review of the properties of the nonferrous metals which are of significance as construction materials in reactors. In the first part of the report, beryllium is discussed. (auth)

5661 GROWTH OF REFRACTORY CRYSTALS USING THE INDUCTION PLASMA TORCH. Thomas B. Reed (Massachusetts Inst. of Tech. Lincoln Lab., Lexington). J. Appl. Phys., 32: 2534-5(Dec. 1961).

Apparatus is described for growing refractory crystals using the induction plasma torch in a Verneuil-type geometry. The plasma torch makes possible crystal growth at higher temperatures than can be achieved with flames and in inert or reactive atmospheres. Conditions are given for growth of sapphire, stabilized zirconia, and niobium crystals. (auth)

5662 STUDY AND DEVELOPMENT IN THE PRODUCTION AND FABRICATION OF ZIRCONIUM IN JAPAN. Yoshitsugu Mishima (Tokyo Univ.). J. At. Energy Soc. Japan, 3: 879-87(Nov. 1961). (In Japanese)

Development work carried out during the past ten years in Japan in the field of production and fabrication of zirconium and its alloys as well as of the fundamental and engineering studies is reviewed. Zircaloy tubes of sufficient dimensional tolerance as specified are successfully fabricated. The modification of the alloy composition of Zircaloy to be fitted to Japan-made sponge of less nitrogen content has also been carried out. (auth)

5663 DIFFUSION MIGRATION OF COBALT IN PROTECTIVE COATING ON MOLYBDENUM. A. I. Borisenko, Zhur. Priklad. Khim., 34: 2175-83(Oct. 1961). (In Russian)

The diffusion of cobalt in molybdenum frit coating as a high-temperature corrosion inhibitor is analyzed. The concentration of cobalt increases from the surface coating down to the boundary layer reaching the maximum at the interface layer over molybdenum. The cobalt migration continues from the outer surface of the coating toward molybdenum. The cobalt concentration gradient depends on the composition of frit coating and the vitreous bond. The cobalt diffusion into molybdenum increases with temperature increases. (R.V.J.)

5664 IMPROVEMENTS IN OR RELATING TO AQUASOLS. Guy B. Alexander and George Wallace Sears, Jr. (to E. I. Du Pont de Nemours & Co.). British Patent 884,975. Dec. 20, 1961.

A method is outlined for preparing stable thoria sols of 50 to 80 wt % ThO_2 in the form of particles with diameters ranging from 10 to 100 mμ. The method comprises adding to a dilute aqueous solution of colloidal ThO_2 a soluble thorium salt and an anion exchange resin the hydroxyl form at controlled rates until the colloidal particles have grown to the desired size. Various aspects of the method, e.g., pH control, concentration of sols, and use, are discussed in detail. (D.L.C.)

Corrosion

5665 (BMI-X-184) CORROSION INVESTIGATION OF HyMu-80 AND INOR-8 UNDER HYDROFLUORINATION CONDITIONS DURING DISSOLUTION OF ZIRCALOY-2. P. D. Miller, E. F. Stephan, and F. W. Fink (Battelle Memorial Inst., Columbus, Ohio). Dec. 1, 1961. Contract [W-7405-eng-92]. 13p.

An experiment was run to determine the durability of HyMu-80 along with INOR-8, under hydrofluorinator conditions, in a molten salt bath of $NaF-LiF-BeF_2$ at 650°C while Zircaloy-2 was being dissolved. The only visible evidence of attack was on those specimens extending through the liquid-vapor interface. These samples were raised with the interface as the zircaloy-2 was added. In this area, there was severe necking-down of all specimens. In general, the HyMu-80 specimens were as durable as the INOR-8 pieces or even more durable. (M.C.G.)

5666 (EURAEC-98) DESIGN AND ASSEMBLY OF A LOOP FOR EXPERIMENTS ON CORROSION AND EROSION PROPERTIES OF FLOWING WET STEAM. Special Report No. 6. E. Brutto, J. Cihi, G. Imarisio, G. Palladino, G. Perona, and R. Sesini (Centro Informazioni Studi Esperienze, Milan). Mar. 1961. Work performed under United States-Euratom Joint Research and Development Program. Contract [002-59-11RD1]. 47p. (CISE-R-34)

A corrosion loop was designed for experiments on the corrosion and erosion effects of flowing wet steam in a heated channel. Diagrams of the loop and a flow-sheet are given. The pump, accumulator, heat regenerator, boiler, transformer, test section, coolers, pressure reducing system, water filtering and de-ionizing system, water tank, piping, support frame, and electrical control and safety system are described. Methods of pressure, power, flow rate, and temperature measurement are discussed. (M.C.G.)

5667 (GEAP-3748) SIMULATED BOILING-WATER-REACTOR CORROSION FACILITY (CL-1). W. L. Pearl, M. D. Fitzsimmons, and M. Siegler (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). June 6, 1961. Prepared for General Electric Co. Atomic Power Equipment Dept., San Jose, California. 40p. (R61APE60)

The design and operation principles of the high temperature boiling water facility (CL-1) are discussed. Some typical results from the first four years of operation are included to properly illustrate the versatility and capabilities of the facility for corrosion testing. (auth)

5668 (MND-E-2655) AUTOCLAVE TESTING OF MONEL, NICKEL AND INCONEL. J. McGrew, S. Frank, and T. Page (Martin Co. Nuclear Div., Baltimore). Oct. 1961. 87p.

Stressed and unstressed specimens of Monel, nickel, and Inconel were exposed to varied environmental conditions to test the resistance of these three metals to corrosion. The experiments were conducted in autoclaves operated at 450°F and 422 psia for 50, 200, and 2000 hours. The environmental conditions included variations in concentration of chloride, oxygen, phase (liquid or vapor) and method of pH adjustment. Statistical methods were employed in designing the experiments and in analyzing the results. An incipient surface dulling was noted on some of the specimens that were tested for 50 and 200 hours, but none of the specimens cracked or pitted. No cracking of any coupons was observed in the 2000-hour autoclave tests, but varying degrees of pitting did occur for all three metals. Typical corrosion rates from the 2000-hour data for coupons exposed to 1000 ppm chloride and 15 ppm oxygen were: Monel, 0.50 mdd; nickel, 0.38 mdd; and Inconel, 0.02 mdd. Based on the results of these tests, the materials are listed in order of preference as follows: Inconel, nickel, and Monel. (auth)

5669 (NP-11171) EXPLORATORY CORROSION TESTS ON MISCELLANEOUS URANIUM-BEARING FERROUS ALLOYS IN ACID SOLUTIONS. G. J. Biefer (Canada. Dept. of Mines and Technical Surveys. Mines Branch). Apr. 13, 1961. 13p. (CURF-R-10; PM-R-61-9).

Exploratory corrosion tests in acid solutions were carried out on U-bearing steels, cast iron, and Cr-steels. It was found that U-bearing alloys pitted less than similar U-free alloys. Data also indicated lower corrosion rates for the U-bearing alloys. (J.R.D.)

5670 (ORNL-3171) IN-PILE-AUTOCLAVE TEST OF ZIRCALOY-2 CORROSION IN $UO_2(NO_3)_2$ SOLUTION AND OF SOLUTION STABILITY. R. J. Davis, G. H. Jenks, E. G. Bohlmann, S. E. Bolt, V. A. DeCarlo, and H. C. Savage (Oak Ridge National Lab., Tenn.). Jan. 15, 1962. Contract W-7405-eng-26. 26p.

A rocking-autoclave experiment was performed in which a D_2O solution of uranyl nitrate (0.032 $\underline{M}$) with $Cu(NO_3)_2$ and excess DNO_3 was exposed in Zircaloy-2. Low-power low-temperature exposures of short duration were made in order to obtain pressure data from which G_{D_2} and K_{Cu} (225°C) values could be estimated. Exposure at 280°C to the full reactor power was made in five periods, the total irradiation time being 134 hr. Pressure and temperature were followed closely both during and between irradiation periods. Analyses were made of the irradiated solution, the autoclave rinse solution, a large amount of precipitate, and the specimen surfaces. The value for K_{Cu} (225°C) was estimated to be 1600 to 1700 liters $mole^{-1}$ hr^{-1}. The G_{D_2} value was estimated to be 1.3 to 1.4. The various pertinent pressure and analytical data were not completely consistent but allow estimates of the Zircaloy-2 corrosion rate of 6 to 12 mils/yr for most of the exposure. The corrosion rate appeared to increase during the last 30 hr of exposure, and the final rate was probably 30 mils/yr or more. From various features of the pressure data, estimates of G_{N_2} of 2×10^{-3} to 2.5×10^{-2} were made, which are 7 to 70 times larger than reported values from fission-fragment irradiations of $Ca(NO_3)_2$ solution. Recombination of nitrogen and oxygen was indicated. If it is assumed that the recombination occurred in the vapor phase, the estimated $G_{NO_3^-}$ value was in the range 1 to 3, which is comparable with values for vapor-phase fixation previously reported by others. (auth)

5671 (TID-14467) THE ELECTROCHEMICAL AND CORROSION CHARACTERISTICS OF RARE EARTH AND YTTRIUM METALS. Annual Progress Report and Renewal Proposal. N. D. Greene (Rensselaer Polytechnic Inst., Troy, N. Y.). Nov. 1961. Contract AT(30-1)-2714. 12p.

Corrosion studies were made on Gd, Dy, Ho, Er, and Y in several moderately corrosive media. The studies indicate that these rare earth metals are very reactive. They react slowly with water and moist air forming dark oxide coatings and are rapidly attacked by most acids at concentrations below one normal at room temperature. However, the metals studied are fairly resistant to strong and dilute alkali solutions, hydrofluoric acid, and dilute phosphoric acid. (P.C.H.)

5672 (WADC-TR-59-575(Pt.II)) OXIDATION OF TUNGSTEN AND TUNGSTEN BASED ALLOYS. P. E. Blackburn, K. F. Andrew, E. A. Gulbransen, and F. A. Brassart (Westinghouse Electric Corp. Research Labs., Pittsburgh). Dec. 1960. Contract AF33(616)-5770. 47p.

The results of studies related to the oxidation of tungsten and its alloys are presented. The pressure of WO_3 polymers over WO_2 was measured in a tungsten Knudsen cell and found to agree with measurements in a platinum cell. Literature data for WO_2 and WO_3 were combined with vapor pressures determined to give thermodynamic values for $W_{18}O_{49}$ and $W_{20}O_{58}$. Tungsten oxidation rates were measured from 800 to 1700°C and in pressures of oxygen between 2×10^{-1} and 10^{-2} atmospheres. The effects of oxygen pressure indicate that the rate may be governed by oxygen dissociating to atoms in the reacting surface. The oxidation rate is demonstrated to be independent of the oxide evaporation rate. All of the evidence indicates that if an oxide barrier layer is present at temperatures above 800°C it must be very thin. Studies on the oxidation of tantalum–tungsten alloys between 800 and 1200°C indicate that the 50-50 alloy has the greatest oxidation resistance, oxidizing at a rate as much as 10 times slower than tungsten alone. (auth)

5673 (DEG-Inf-Ser-111) CATALYTIC EFFECTS IN THE AIR OXIDATION OF GRAPHITE. H. Hering, S. Keraudy, F. M. Lang, and S. May. Translated by V. J. Wilkinson (U.K.A.E.A. Development and Engineering Group, Risley, Lancs, Eng.) from p.115-22 of "Proceedings of the Fourth Conference on Carbon" (a publication of Pergamon Press, New York, 1960). 14p. (DPC.CPh/59-566)

Issued as French reprint, CEA-1815.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 17266.

5674 HYDROGEN ABSORPTION BY ZIRCALOY-2 AND SOME OTHER ALLOYS DURING CORROSION IN STEAM. B. Cox (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Electrochem. Soc., 109: 6-12(Jan. 1962).

The results for hydrogen uptake by Zircaloy-2 during corrosion in steam are presented. The hydrogen absorption curve consists of three regions: in the first, covering the growth of the interference-color oxide film, about 30-50% of the hydrogen released by the corrosion reaction is absorbed; in the second, hydrogen absorption falls to a low value; and in the third, following the transition in the oxidation kinetics, it rises to 80-100% of the hydrogen released by the corrosion reaction during this period. A mechanism for the hydrogen absorption is offered based on the differing oxidation mechanisms in these three periods. The hydrogen absorption behavior of other alloys is similar for those alloys which show oxidation kinetics similar to Zircaloy-2. (auth)

5675 CORROSION OF NICKEL IN HYDROLYZING SOLUTIONS. Yu. M. Pozin (Scientific Research Accumulator Inst., [USSR]). Zhur. Priklad. Khim., 34: 2248-53(Oct. 1961). (In Russian)

The electrochemical and corrosion behavior of metallic nickel powder in cadmium chloride solution is studied. (R.V.J.)

5676 CARBON STEEL CORROSION IN HIGHLY CONCENTRATED NITRIC ACID CONTAINING HALOGEN COMPOUNDS. I. P. Mukanov and S. D. Beskov (Moscow State Teacher's Coll.). Zhur. Priklad. Khim., 34: 2282-8(Oct. 1961). (In Russian)

Iodine and its compounds are effective inhibitors against corrosion of carbon steel in highly concentrated nitric acid. The protective action remains effective in boiling acid solutions however the protective action is not effective in the vapor phase. The oxidation-reduction potentials of HNO_3 do not change with iodine admixtures. (R.V.J.)

5677 EFFECTS OF CARBON ON X18H9 STAINLESS STEEL CORROSION CRACKING. B. V. Linchevskii and V. V. Romanov. Zhur. Priklad. Khim., 34: 2356-9(Oct. 1961). (In Russian)

The effects of C on the rate of chromium–nickel austenitic steel corrosive cracking in 42% boiling $MgCl_2$ solutions are studied. It is shown that C concentrations from 0.1 to 0.01% does not stop the stainless steel from intracrystalline cracking. The resistance to cracking increases with C concentration from 0.05 to 0.07%. (R.V.J.)

Fabrication

5678 (AECL-1382) SINTERED UO_2 FUEL PELLETS. C. A. Seger (Canadian General Electric Co., Ltd., Toronto). Oct. 1961. 57p.

Sintered UO_2 fuel pellets for use in the NPD reactor are being fabricated from ceramic grade uranium dioxide powder by cold pressing followed by sintering in a hydrogen atmosphere at high temperature (1600°C). The work done on determining the effect of variables in the Carboloy process on pellet integrity and manufacturing costs is described. The results show that in the Carboloy process the die wall lubricant must be applied in an even film as a readily evaporated solution. It is also shown that straight wall dies cannot be used to press compacts from the powder used, and coupled with manufacturing experience indicates that die geometry is a function of a powder characteristic. The results also show that the Carboloy process operates at or very near what appear, from the results of the tests, to be the optimum processing conditions for the type of UO_2 powder in use. (auth)

5679 (APEX-276) FABRICATION PROCEDURES FOR NIOBIUM FUEL RIBBON. J. R. Lewis (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 1956. Decl. June 9, 1961. Contracts AF33(038)-21102 and AT(11-1)-171. 23p.

Basic fabrication procedures for niobium fuel ribbon are described. The fabrication processes involve edge-welding, pressing, sintering, hot-pressing, and rolling operations. From the work on these procedures it was concluded that: niobium fuel ribbon can be clad with Fe–Cr–Al alloy; the quality of clad-to-core bonds is not as high as in 80 Ni–20 Cr alloy; oxidation resistance of cladding is insufficient to protect niobium cores when cladding is in the form of 0.004 inch of 70 Fe–25 Cr–5 Al alloy. The status of niobium fuel element development is covered to June, 1956. (P.C.H.)

5680 (ARF-2210-6) IMPROVED VANADIUM-BASE ALLOYS. Final Report [for period] December 1, 1960 to November 30, 1961. B. R. Rajala and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Dec. 20, 1961. Contract NOw 61-0417-c. 41p.

Alloys based on V–5 wt % Ti–20 wt % Nb and V–60 wt % Nb were found to exhibit excellent fabricability and weldability with good retention of strength to at least 2200°F. Ultimate tensile strength values of materials at the 60 wt % niobium level measured under helium were above 60,000 psi at 2000°F and up to 44,400 psi at 2200°F; the strongest alloy at 2200°F was V−1 wt % Hf−60 wt % Nb. Materials at the 20 wt % niobium level were at least 30% lower in strength at all temperatures. Stress-rupture properties at 2000°F of compositions based on V−5 wt % Ti−20 wt % Nb and V−60 wt % Nb were substantially improved by addition of 0.05 wt % carbon. Interstitial impurities in the raw materials and those picked up during melting and hot working were found to reduce workability and to increase elevated-temperature strength. Tensile data obtained at elevated temperatures under vacuum were lower than those measured under helium from reduced pickup of interstitials during testing. Alloys based on V−Ti−(Nb)−Si exhibited interesting age-hardening characteristics at 1200°F. Exposure to a saline environment under stress at 800 and 1000°F did not impair the mechanical properties of V−5 wt % Ti−20 wt % Nb, although slight pitting was observed at 1000°F. (auth)

5681 (BMI-X-185) PROGRESS ON USAEC/AECL COOPERATIVE PROGRAM. Quarterly Report for Period September-November 1961. Stanley W. Porembka (Battelle Memorial Inst., Columbus, Ohio). Dec. 1, 1961. Contract W-7405-eng-92. 31p.

Progress on investigations of cold-bonding methods and creep-rupture properties in areas of interest to the Canadian reactor program is reported. The effects of surface roughness in cold-joining zircaloy-2 and Type 410 stainless steel were studied. Additional experiments were conducted using gold and silver as intermediate layers. Friction-bonding studies were devoted to the feasibility of end capping SAP alloy fuel sheaths by friction methods. Encouraging results in forming end-cap configurations were attained by a friction-extrusion technique. The explosive-joining studies emphasized the optimization of charge parameters as related to impacting previously roll-formed assemblies. (M.C.G.)

5682 (DMIC-163) CONTROL OF DIMENSIONS IN HIGH-STRENGTH HEAT-TREATED STEEL PARTS. A. R. Elsea, T. H. Feron, and A. M. Hall (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Nov. 29, 1961. Contract AF33(616)-7747. 38p.

Problems encountered in producing heat-treated steel parts to very close dimensional tolerances are discussed. The roles of various metallurgical variables in promoting changes in size and shape of heat-treated steel parts are described, and methods are suggested for minimizing dimensional instabilities in processing and in service. (auth)

5683 (EURAEC-115) PRODUCTION OF BLENDED OXIDE PELLETS (UO_2-ThO_2) BY SINTERING IN AIR. Quarterly Report No. 3. (Compagnie Industrielle des Combustibles Atomiques Frittés, Corbeville, par Orsay (Seine-et-Oise), France). [nd.]. Work performed under United States-Euratom Joint Research and Development Program. Contract [014-60-9RDF]. 32p. (Includes original, in French, 22p.).

The sintering in air of UO_2-ThO_2 mixtures made it possible to obtain blends with a density exceeding 98% theoretical. These results were obtained both on pellets shaped by pressing and on extruded rods. Sintering $U_3O_8-ThO_2$ mixtures gave definitely inferior results both in air and in hydrogen. A trial sintering in a gas-heated industrial furnace was carried out successfully. Continuation of the gravimetric tests for determining the O/U ratio, as well as the examination by x-ray diffraction, confirmed the nonstoichiometry of blends sintered in air. Micrographical examination of a series of pellets showed the importance of the density "crude" on the structure of the sintered products. Observations were made of pellets sintered for 500 hr in hydrogen at 1650°. (M.C.G.)

5684 (NAA-SR-6213) FABRICATION DEVELOPMENT OF APM ALLOYS FOR FUEL ELEMENTS. E. G. Kendall, G. V. Alm, W. H. Friske, M. H. Binstock, B. N. Briggs, and B. Gradle (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 15, 1961. Contract AT(11-1)-Gen-8. 25p.

The development work being done to adapt aluminum powder metallurgical products (APM) for organic reactor fuels is described. An APM alloy, Alcoa M257 alloy, containing 5 to 7 wt % finely dispersed Al_2O_3 in pure aluminum matrix, was tentatively selected as a cladding for UO_2 fuel pellets, on the basis of its superior creep and tensile properties to 900°F. Mechanical properties of M257 alloy, together with its formability, weldability, and adaptability to fuel element requirements, are described. Details of the following fabrication developments are presented: Description of AMP finned fuel cladding tubes formed to close tolerances by impact extrusion. Tube dimensions were 0.305-in. ID by 0.030-in. wall containing eight longitudinal external fins. Extruded AMP square box shapes for fuel bundle containment. Silver eutectic diffusion bonding process development for obtaining end closures in M257 aluminum fuel tubes. Special techniques used for assembly and thermocouple instrumentation of M257 clad, uranium dioxide fueled prototype fuel elements. (auth)

5685 (NAA-SR-6431) FABRICATION AND WELDING CHARACTERISTICS OF HIGH STRENGTH ZIRCONIUM ALLOY 3Z1. R. K. Wagner (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 15, 1961. Contract AT(11-1)-Gen-8. 50p.

A high-strength zirconium alloy (Zr-1.25 Al-1 Sn-1 Mo) was processed and fabricated on a production scale. A variety of mill products, including forged billets, strip, bar, and tubing, were produced. In the course of the production effort, a wide range of fabrication variables was studied. Such factors as the effect of annealing temperature, hot-rolling temperature, cold-rolling procedures, and the amount of cold work on room and elevated temperature tensile properties were investigated. In an investigation of welded material, it was found that the weld ductility responded favorably to vacuum annealing. (auth)

5686 (NEPA-1517) PROTECTIVE COATINGS FOR BERYLLIUM CARBIDE-BEARING FUEL-ELEMENT BODIES. H. E. Wagner, H. F. Reid, L. S. O'Bannon, and C. G. Harman (Battelle Memorial Inst., Columbus, Ohio). June 12, 1950. Decl. Sept. 11, 1961. For Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn. Contract [W-33-08-ac-14801(16250)]. 70p. (BMI-N-44)

Work is summarized on the development of protective coatings for beryllium carbide-base bodies from the inception of the project in Jan. 1948 to May 15, 1949. The protective qualities of experimental coatings for bodies composed chiefly of beryllium carbide were established as being closely related to the porosity of the underbody. Five types of coatings were developed which protected bodies having apparent porosities of less than 25%. No promising coatings were obtained for underbodies of higher porosity. Coatings which protected the most dense compacts of beryllium carbide, particularly those containing additions of 0 to 5% of uranium carbide, against oxidation at 2500°F for periods of more than 600 hr were prepared. Compositions and temperatures are tabulated. (C.H.)

5687 (NYO-9584) APPLICATIONS OF ULTRASONIC ENERGY. TASK 2. ULTRASONIC METAL AND CERAMIC POWDER PROCESSING. TASK 3. ULTRASONIC INSTRUMENTATION. Progress Report No. 28, June 1, 1961 to July 31, 1961. (Aeroprojects, Inc., West Chester, Penna.). Aug. 1961. Changed from OFFICIAL USE ONLY Aug. 18, 1961. Contract AT(30-1)-1836. 34p.

Continued application of ultrasonic activation to slip casting molds after the mold was filled resulted in removal of significant quantities of water from the slip. In the preparation of cylindrical slip-cast cermet bars, activation for 5 min after filling resulted in green specimens with 54% less water than nonactivated control specimens of the same composition. Cylindrical ceramic specimens are being prepared under controlled conditions to study the effects of ultrasonic power and activation time on properties. One group of specimens showed improvement of green density with ultrasonic activation and further improvement resulting from continued ultrasonic activation after the mold was completely filled. Stainless steel-clad tubes filled with arc-fused, ground, and sized ThO_2-UO_2, ultrasonically compacted to 91.8% of theoretical density, were examined by x rays and found to be free of voids and gross density variations. By measurement of the outside diameters of the tubes, they were found to be also free of distortion. Standard pelleting techniques and the use of an ultrasonically activated punch eliminated problems of capping and cracking of pellets indicative of relative freedom from residual stresses. Without ultrasonic activation of the punch no usable pellets were obtained. It was shown that calcium fluoride cylinders can be produced at temperatures well below the normal hot pressing temperature through the use of an ultrasonically activated punch. Ultrasonic instrumentation is under investigation for specialized use in nuclear reactor operation. Advances in the techniques for the detection and measurement of incipient boiling, foam-level, and changes in gas or liquid suspension properties are reported. Earlier indications that localized incipient boiling in critical areas of water-cooled reactors could be detected by the use of ultrasonic sensing elements of modest face diameter were substantiated by results obtained using a $^1/_{16}$-in.-diameter probe. Ultrasonic standing-wave-ratio measurement was shown to have sufficient sensitivity to detect and to measure changes in the water-content of simulant foams. This was validated by tests on actual foam generated from steam and water such as would be encountered in reactors of the EBWR type. A simple bench test of a resonant column for gas-dispersed-particle measurement in fluidized bed reactors indicated the expected reduction in amplitude. The ultrasonic impedance ratio as measured by a sensing element in a liquid suspension (simulating the thoria blanket in an aqueous homogeneous reactor) was shown to vary with the concentration of the liquid-dispersed particles. Indication of particle-size dependency was confirmed. (auth)

5688 (ORNL-3184) REMOTELY CONTROLLED SHEARING OF PIPE AND STRUCTURAL MEMBERS. A. A. Abbatiello (Oak Ridge National Lab., Tenn.). Dec. 28, 1961. Contract W-7405-eng-26. 14p.

A shearing tool was developed for remotely controlled severing of pipes or structural members. The shear is rotated about its axis in a wrist motion by the pumped hydraulic fluid that also powers the shear blade. It can be used in a stationary mounting or suspended from a crane. A C-shaped support for the shear was designed to pass through a small top opening of a shielded cell. The controls for manipulating the shear pass through or along the C-frame. The shear jaw opens to 5 in. in height and 7 in. in width, and the total weight of the tool is only 575 lb. It was used to cut metal sections $4\frac{3}{4}$ in. thick and 4-in. sched.-40 stainless steel pipe. (auth)

5689 (ORNL-TM-94) EXPERIMENTAL ATTEMPTS TO STABILIZE A CUBIC FORM OF BeO. R. E. Thoma, H. A. Friedman, and T. N. McVay (Oak Ridge National Lab., Tenn.). Dec. 22, 1961. Contract [W-7405-Eng-26]. 7p.

Binary mixtures of BeO with the oxides Al_2O_3, CaO, Li_2O, MgO, Sc_2O_3, TiO_2, Y_2O_3, and ZrO_2 were fired to temperatures in excess of 2050°C in an attempt to produce a stabilized cubic crystalline modification of BeO. No evidence was observed in microscopic and x-ray diffraction analyses of the cooled specimens that a cubic form of BeO had formed in the experiment. (auth)

5690 (ORO-477) SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS. Second Quarterly Report [for period] June 1 through August 31, 1961. K. M. Taylor and C. H. Murtry (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). Sept. 15, 1961. Contract AT(40-1)-2558. 12p.

Activities in a program to determine the effects of impurities such as O, C, N, U, and Fe on the irradiation behavior of UC are reported. Results are presented of work done in an effort to define optimum conditions for obtaining high-density sintered pellets of stoichiometric UC, and UC plus certain impurities. Factors affecting pellet density studied include the thermal history of the UC powder prepared by reacting UO_2 and C for various times and temperatures, pellet sintering time and temperature, added impurities, and the addition of Ni as sintering aid. A description of initial fabrication of 10% enriched irradiation samples is included. (J.R.D.)

5691 (SCR-306) DEVELOPMENT OF MILITARY COMPONENTS FROM BERYLLIUM BY SLIP CASTING AND POWDER METALLURGY TECHNIQUES. Final Report, September 1959–September 1960. (Stevens Inst. of Tech., Hoboken, N. J. Powder Metallurgy Lab.). Dec. 1961. For Sandia Corp., Albuquerque, N. Mex. Contract [AT(29-1)-789]. 74p.

The possibility of developing new methods to improve upon the conventional processes for fabricating beryllium metal into finished components by vacuum hot pressing powder and machining blanks thus made to desired configuration and size was studied. The program was primarily devoted to a study of the slip casting of beryllium metal powder and its progressive manipulation into dense structures in the form of small, medium, or large, hollow or solid, complex shapes. During the progress of this work, mechanically cold pressed and vacuum sintered beryllium metal powder was investigated as a means of comparison with slip cast products. A limited amount of work was initiated for the extrusion of slip cast and vacuum sintered preforms of beryllium metal powder. In the beginning of this work it was necessary to purchase and install vacuum sintering furnace equipment with a heating zone 6 inches in diameter by 10 inches high. The space in which this furnace was located with its associated pumping equipment and instrumentation required an enlargement of the laboratory toxic area. While this was being done, a smaller tube furnace was made available by the purchase of additional pumping equipment for preliminary studies. The tentative slip casting procedure for beryllium metal powder requires control of such factors as the particle size of powder; the use of selected organic suspending media, and dispersing and binding agents; the pH of the slip; its viscosity and rheology; the time and temperature of drying the green castings and finally; their sintering in vacuum with suitable granular packing material. When these variables were resolved into a tentative procedure, beryllium test pieces were consistently produced with a density greater than 98.5% of relative density and an ultimate bending stress on the order of 58,000 psi and an ASTM grain size of 6 to 7.

No material contamination of the sintered beryllium metal apparently resulted from the binder vehicle. However, it is considered possible that the beryllium vapor believed to be present during sintering may react with the packing medium effecting a consequent contamination of the beryllium compact from the products of this reaction, whatever they may be. The data reported were determined with the assumption that the part did not materially change in analysis during sintering. If significant changes in composition did indeed occur, the reported relative densities do not adequately reflect residual porosity. Micro examination did not, however, reveal any porosity. Cold pressed and vacuum sintered beryllium metal powder packed in aluminum oxide consistently resulted in test pieces of 99.5% of relative density. These generally displayed ultimate bending stresses of 60,000 psi and ASTM grain size of 6 to 7. In two specimens, these cold pressed and sintered pieces proved to be approximately 100% relative density with ultimate bending stress of 90,000 psi and an ASTM grain size of 7 to 8. The extrusion of slip cast and sintered beryllium slugs of various densities was performed satisfactorily. Canning was resorted to only as a precautionary measure for toxicity. The successful extrusions produced under these circumstances were not subjected to either physical or chemical analysis. The slip casting of beryllium preforms for subsequent warm forging without protection is now being investigated. (auth)

5692 (WADD-TR-60-917) FUSION WELDING OF BERYLLIUM. B. M. MacPherson and W. W. Beaver (Brush Beryllium Co., Cleveland). Jan. 1961. Contract AF33(616)-6413. 63p.

A background section describing accomplishments related to the fusion welding program is included. The standard conditions used for fusion welding of beryllium are also given. Studies of the effects of post-heat treatment and fixturing on fusion welds are reported, along with limited studies of multiple-pass welding and fillet welding of beryllium. The effects of residual impurities on the weldability of beryllium are also discussed. Also, drawn beryllium welding wire was coated with Cu, Ag, Au, Ni, Fe, Co, Sn, Cr, Zn, and Cd; the effects of these coated wires upon the fusion weld properties of beryllium are described. (auth)

5693 (XDC-59-1-173) FABRICATION, WELDING AND TESTING OF 17-7 PH STAINLESS STEEL. G. L. Smith (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 10, 1958. Decl. June 16, 1961. Contract [AT(11-1)-171]. 97p.

The fabrication and heat treatment of a scroll, elbows, and transitions made from 17-7 PH stainless steel plate in thicknesses varying from one-quarter inch to three inches are reported. Inert gas-shielded tungsten-arc welding procedures for 17-7 PH stainless steel are presented in detail. The material handling and welding techniques necessary to achieve ultra-high quality multipass welded joints in 17-7 stainless steel are also described. Due to the physical characteristics of 17-7 PH it was necessary to zone anneal the edges of the scroll and elbow, after heat treatment and before welding the flanges to the unit. A detailed description of the zone annealing procedure is included, along with the fabrication procedure for each component of each unit and the assembly of the components. The results of physical tests made on the parent metal and welded specimens aged at 1000, 1050, 1100, and 1150°F, properties of transverse specimens, and the results of tests made on special sections, which duplicated conditions found in fabrication, are also included. It was concluded that 17-7 PH stainless steel plate can be used to construct critical components, providing the physical characteristics of the material are recognized, and the design of the unit takes into consideration the low short-transverse properties of the heat treated material. (auth)

5694 (CEA-tr-X-257) PROCEDE DE FABRICATION D'ALLIAGES LEGERS AU BERYLLIUM ET DE BERYLLIUM PUR (CLASSE III). (Procedure for Fabrication of Light Alloys of Beryllium and of Pure Beryllium (Class III)). Translated into French from Italian Patents 348,085, Oct. 19, 1936 and 351,374, Apr. 29, 1937. 27p.

A procedure is given for the fabrication of light beryllium alloys and pure beryllium. In the fabrication of the beryllium alloys, alloys composed of metals less electropositive than beryllium united with more electropositive metals are used. These alloys have definite concentration in the mixture with low fusion point with respect to that of the components and react by double exchange with beryllium salts. Alloys with more than 20% Be are obtained by double exchange without passing the fusion temperature of the eutectic or eutectoid mixture formed by the beryllium with the other metals to be alloyed. The metals and metalloids which can be alloyed in this manner with beryllium are lithium, sodium, magnesium, potassium, calcium, rubidium, strontium, cerium, barium, boron, carbon, and silicon. (tr-auth)

5695 (CEA-tr-X-258) PROCEDE DE FABRICATION DU BERYLLIUM OU DES ALLIAGES DE BERYLLIUM. (Fabrication Procedure for Beryllium or Beryllium Alloys). Translated into French by L. Roulet from Italian Patent 350,669. Apr. 29, 1937. 25p.

An industrial process for the fabrication of beryllium or beryllium alloys is presented. It is based on the replacement of beryllium from its fluoridated compounds by more electropositive metals or metalloids. The advantages of the procedure are tabulated, and the conditions for its optimum yield are discussed. Examples are given. (J.S.R.)

5696 THE PREPARATION OF THIN SELF SUPPORTING BORON FILMS. A. H. F. Muggleton and F. A. Howe (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 13: 211-14(Sept. 1961). (In English)

A method of producing thin (20 to 100 $\mu g/cm^2$) self supporting films of boron by vacuum evaporation is described. The high evaporating temperature required is obtained by electron bombardment. The merits of various crucible materials are discussed and a technique for mounting the foils is described. (auth)

5697 THE PREPARATION OF BERYLLIUM–MAGNESIUM ALLOYS BY POWDER-METALLURGICAL METHODS. J. W. S. Jones and J. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Powder Met., No. 8, 37-41(1961). (AERE-M-828)

The preparation of alloys of beryllium and magnesium containing up to 20 wt % magnesium is described. Dense bodies may be prepared by infiltration of beryllium skeletons with molten magnesium or by liquid-phase sintering of cold-compacted mixed elemental powders. Such alloys consist of the appropriate element together with the compound $MgBe_{13}$, usually present as a continuous intergranular phase. (auth)

5698 PRELIMINARY OBSERVATIONS ON THE USE OF THE INDUCTION-COUPLED PLASMA TORCH FOR THE PREPARATION OF SPHERICAL POWDER. H. J. Hedger and A. R. Hall (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Powder Met., No. 8, 65-72(1961).

The operating characteristics of an induction-coupled plasma torch are described. Preliminary observations are given on its use for the spheroidization of chromium, alumina, molybdenum, magnesia, tantalum, and tungsten powders. (auth)

5699 HOT PRESSING HIGH-TEMPERATURE COMPOUNDS. J. S. Jackson (Associated Electrical Industries, Ltd., Rugby, Eng.). Powder Met., No. 8, 73-100(1961).

The technique of hot pressing and the factors to be considered in designing suitable equipment are discussed. Examples are quoted of three main classes of materials: unbonded hard materials, materials containing a small amount of a cementing phase or impurity affecting densification, and materials containing an appreciable amount of a cementing phase. Current theories concerning the mechanism of densification during hot pressing are discussed. (auth)

5700 THE SINTERING OF URANIUM-CARBON-IRON ALLOYS IN THE PRESENCE OF A LIQUID PHASE. M. C. Regan and J. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Powder Met., No. 8, 128-44(1961).

The preparation of uranium monocarbide bodies containing ~1% open porosity and with a density of ~12.4 g/cc by cold compacting and sintering uranium/graphite mixtures is described. The effect of iron additions in producing a liquid phase during sintering is also studied, and it is shown that the addition of 10 wt % UFe_2 to the stoichiometric mixture of uranium and graphite raises the sintered density to ~13.1 g/cc and reduces the open porosity to ~0.5%. The mechanism of carbide formation and densification in the presence of a liquid phase is discussed. (auth)

5701 METHOD OF MAKING FUEL ELEMENTS. Australian Patent 223,431. Feb. 27, 1958.

A process is described for enclosing a plate of first metal with a second metal. The process comprises the steps of inserting the plate into an aperture of a frame of a second plate, placing a sheet of second metal on each of opposite faces of the assembled plate and frame, purging with an inert gas the air from the space within the frame and the sheets, exhausting said space, purging said space with air, reexhausting said spaces, sealing the second aperture, and applying heat and pressure to bond the sheets, the plate, and the frame to one another.

5702 PROCESS OF MAKING A NEUTRONIC REACTOR FUEL ELEMENT COMPOSITIONS. Australian Patent 223,664. Apr. 1, 1958.

A process is given for making a ceramic-like material suitable for use as a nuclear fuel. The material consists of a solid solution of plutonium dioxide in uranium dioxide and is produced from a uranyl nitrate-plutonium nitrate solution containing uranium and plutonium in the desired ratio. The uranium and plutonium are first precipitated from the solution by addition of NH_4OH and the dried precipitate is then calcined at 600°C in a hydrogen atmosphere to yield the desired solid solution of PuO_2 in UO_2.

5703 METHOD OF PREPARING A FUEL ELEMENT FOR A NUCLEAR REACTOR. Australian Patent 225,692. Dec. 30, 1957.

The method comprises forming a mixture of thorium dioxide and an oxide of uranium in which the oxidation state is at least as high as that in U_3O_8 into a desired shape and firing in air at a temperature sufficiently high to reduce the higher uranium oxide to uranium dioxide.

5704 METHOD OF BONDING. Australian Patent 228,152. Sept. 25, 1958.

A process is given for cladding a plurality of stacked spaced-apart plates of first metal with a second metal. The process comprises the steps: surrounding each plate in a nongastight envelope of second metal, placing flat filler plates of third material and strips of second metal between adjacent plates of first metal to space them apart, placing the assembly into a close fitting envelope of fourth material, evacuating the envelope, sealing the envelope, surrounding the sealed envelope by an inert gas under superatmospheric pressure, heating the assembly in the pressurized gas above the plastic flow point of the second metal but below the melting point of any of the metals for a period of time sufficient to form an integral bond between the strips and envelope of second metal and between the envelope of the second metal and the flat plates of the first metal, slowly cooling the assembly to room temperature, removing the envelope of fourth material, and etching out the filler plates of third material without affecting the second metal.

5705 SOLID STATE BONDING OF THORIUM WITH ALUMINUM. Australian Patent 229,115. Feb. 10, 1959.

A method of bonding thorium and aluminum comprises placing clear surfaces of thorium and aluminum in contact with each other and hot-pressing the metals together in a protective atmosphere at a temperature of about 375 to 575°C and at a pressure of at least 10 tsi to effect a bond therebetween.

5706 IMPROVEMENTS RELATING TO GAS-CONTAINING METAL COATINGS. (to Radiation Research Corp.). British Patent 885,724. Dec. 28, 1961.

An apparatus is described for sorbing a gas in a film upon a substrate. In operation, the substrate in cylindrical configuration is disposed around an elongated heat source bearing a sorber metal, undesired gases are removed, the sorber metal and substrate are degassed, the sorber metal is evaporated onto the substrate, and a gas is sorbed in the newly formed film. The apparatus and method is particularly applicable to the formation of Ti or Zr films with sorbed tritium. (D.L.C.)

Properties and Structure

Refer also to abstract 5548

5707 (AD-261335) THERMODYNAMIC INVESTIGATION OF CERAMIC MATERIALS AT ELEVATED TEMPERATURES. Quarterly Report, March 15, 1961 to June 15, 1961. Michael Hoch (Cincinnati. Univ. Research Foundation). Aug. 1, 1961. Contract AF33(616)-6299. 8p.

The partial free energy of oxygen in FeO was measured at 1200 to 1450°K at the two phase boundaries of the FeO (Wustite) phase with a $Fe_3O_4 \mid FeO \parallel Electrolyte \parallel FeO \mid Fe$ cell. The data were fitted to the equation $\bar{F}_{O_2} = RT \ln N + C_1(1-N)^2 + C_2$. X-ray diffraction patterns of 70% Cr-30% Ni alloys at 1300°C gave no evidence of fcc Cr. (D.L.C.)

5708 (ASD-TR-61-301) FRICTION AND WEAR CHARACTERISTICS OF CERMETS AT HIGH TEMPERATURE AND HIGH VACUUM. R. D. Brown, R. A. Burton, and P. M. Ku (Southwest Research Inst., San Antonio). Sept. 1961. Contract AF33(616)-7209. 33p.

The friction and wear characteristics of several bearing substrate materials and lubricants were determined over a temperature range from ambient to 2000°F, and in normal atmosphere with pressure varied from 760 to 10^{-6} mm Hg. The sliding speed was 14 to 20 fpm. The load ranged from 1500 to 15,000 psi. Two oxide-bonded cermets ($Cr-Al_2O_3-W$ and $Cr-Al_2O_3-Mo-TiO_2$) were found to exhibit low wear and moderate friction when run against themselves throughout a wide range of test conditions. A third cermet ($Cr-Al_2O_3$) showed very poor frictional properties. Three high-temperature alloys were also investigated for purposes of comparison. Test results are also presented which indicate that two of the cermets were effectively lubricated by precious metal films. (auth)

5709 (ASD-TR-61-339) EFFECT OF CREEP-EXPOSURE ON MECHANICAL PROPERTIES OF 80Ni−20Cr AND TZM MOLYBDENUM ALLOYS. Jeremy V. Gluck and James W. Freeman (Michigan. Univ., Ann Arbor). June 30, 1961. Contract AF33(616)-6462. 71p.

An extensive investigation was made of the influence of creep-exposure at 1000 to 1800°F on the mechanical properties of a structurally stable 80Ni−20Cr alloy. Strain hardening and residual stresses raised strength and lowered ductility for creep at the lower temperatures. With increasing temperature of creep, this factor diminished. Internal microcracking in the grain boundaries, however, then occurred increasingly with exposure temperature and creep strain. A remarkably large amount of microcracking was required to reduce ductility and, when more severe, to reduce ultimate tensile strength. Two grain sizes were investigated. The fine grained material was less damaged by cracking than the coarse grain material for a given exposure. It was, however, subject to grain growth at intermediate temperatures with a loss in strength. The results suggest that internal cracking must be extensive for appreciable damage. This is probably due to the low strength and highly ductility of the alloy. A higher-strength alloy would almost certainly show more damage to the properties from increased notch sensitivity. In other alloys studied previously, thermally-induced structural changes were a major factor. Other than the instability of the fine grained material, there was little evidence of this for the 80Ni−20Cr alloy. There were, however, impurities and minor phases present which could have been a factor. Due to uncertainties of material and experimental difficulties, no conclusive results were obtained with TZM molybdenum alloy, 0.55Ti-0.064Zr-0.017C. (auth)

5710 (BMI-X-117) THE EFFECT OF CHANGING TEMPERATURE ON THE INTERNAL FRICTION OF URANIUM. R. E. Maringer (Battelle Memorial Inst., Columbus, Ohio). [1954]. Decl. Dec. 28, 1961. 14p. Contract [W-7405-Eng-92].

The variation of the internal friction of alpha-swaged uranium wire was studied as a function of temperature, heating rate, strain amplitude, and strain rate. A peak associated with the stress-induced motion of twin boundaries and a peak associated with grain boundary relaxation and the alpha-beta transformation were observed. The internal friction is shown to increase linearly with both heating and strain rates. This damping loss was interpreted as resulting from the change in dimensions of twinned areas during straining. (auth)

5711 (CNLM-2154) DIFFUSION OF XENON IN COLUMBIUM. D. P. Gregory and H. W. Leavenworth (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Nov. 20, 1959. Decl. May 9, 1961. Contract [AT(11-1)-229]. 2p.

The diffusion coefficient was calculated for the diffusion of Xe through Nb and found to be 0.064 exp (−18,600/RT). (M.C.G.)

5712 (EURAEC-129) SWELLING OF URANIUM. Quarterly Progress Report No. 3, April−June 1961. (Brussels. Centre d'Etude de l'Energie Nucleaire). Aug. 1961. Work performed under United States-Euratom Joint Research and Development Program. Contract [002-60-10RDB]. 41p.

A transmission electron microscopy study was made of dislocation distribution and radiation damage in Pt. Thin beaten Pt foils were annealed and irradiated in contact with U. In annealed, unirradiated samples dislocations are arranged in a well-developed substructure. The irradiated foils showed black dots which were observed to be preferentially formed on coherent twin boundaries. This phenomenon was accepted as evidence that focusing collisions take place in the Pt, and results are discussed on this basis. Results obtained in irradiation of annealed or quenched foils by fission fragments are also discussed. In research on U, efforts were made to obtain very thin films of oxide-free material for study of dislocations. (J.R.D.)

5713 (GAMD-860) STRESS IN INNER GRAPHITE CAN. R. Turner (General Atomic Div., General Dynamics Corp., San Diego, Calif.). July 2, 1959. Contract AT(04-3)-314. 5p.

A force diagram representing maximum stresses in the inner graphite fuel can where the end cap exerts a moment on the can wall is presented. Equations for calculating the stresses are given. A plot was obtained of maximum stress in can wall versus internal gas pressure. Calculations are also given for thermal stresses in the inner can far from end caps. (M.C.G.)

5714 (NEPA-1050) SPECIAL REPORT ON FABRICATION AND CHEMICAL REACTIVITY OF MOLYBDENUM. Murray A. Schwartz (Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn.). May 1949. Decl. July 18, 1961. Contract [W-33-08-ac-14801(16250)]. 24p.

A compilation and correlation of data from the available literature (to March 1949) on both the fabrication of molybdenum compacts by pressing and sintering methods and the chemical reactivity of molybdenum with such materials as graphite, uranium compounds, metallic carbides, and refractory metals are presented. Comparatively little information was found available which would apply to the fabrication of high density molybdenum compacts containing up to 10% by weight of a uranium compound by pressing and sintering methods within a temperature range of 1100 to 2100°C (2012°−3812°F). (auth)

5715 (NMI-2098) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report to United States Atomic Energy Commission for August 1961. (Nuclear Metals, Inc., Concord, Mass.). Nov. 28, 1961. Contract AT(30-1)-1565. 11p.

Compacts of ruthenium, tungsten, and hafnium were made at pressures of approximately 30,000 psi. Servicing of the arc melter was completed. The use of a polentiostat in microstructure studies is discussed. Crack formation in thick oxide films of zirconium by decoration with HCl was studied. Tests indicated that the exposure time necessary for the decoration of cracks would be of the order of 4 to 6 hr at 700°C. A limited amount of volatile chloride of foreign metals was reacted with the oxide film of a preoxidized zirconium coupon. All specimens prepared in this manner exhibited poorer corrosion resistance than the zirconium standard coupon. Zone-refined beryllium crystals of high purity were produced with controlled orientation by fusing an oriented "seed" crystal to the material to be zone-refined at the beginning of a zone-refining pass. (M.C.G.)

5716 (NP-10972) GRAIN BOUNDARY CRACKING IN METALS UNDER STRESS AT ELEVATED TEMPERATURES. Final Report. Leonard Berenbaum, Jack Brett, and Leslie Seigle (General Telephone and Electronics Labs.

Inc., Bayside, N. Y.). June 15, 1961. Contract NOnr 2613-(00). 104p. (TR-61-103-1)

A study was made of the effect of purification and of a number of metal and oxide additions upon the occurrence of intergranular cracking in brass, copper, nickel, titanium, and zirconium under tension at elevated temperatures. Purification by a variety of means inhibited intergranular cracking in brass, copper, and nickel, and it is suggested that these metals freed of trace impurities, particularly non-metallic impurities, would not exhibit intergranular fracture. Zirconium additions also decreased the frequency of grain boundary cracks in brass and copper, while Al_2O_3 additions increased the number of cracks. Under a wide variety of conditions, titanium and zirconium of commercial purity were immune to grain boundary cracks and intergranular fracture. This behavior is thought to be related to the high affinity of titanium and zirconium for elements such as oxygen and nitrogen, and/or the ability of titanium and zirconium to dissolve their oxides and nitrides. A few experiments were performed to demonstrate the parallel effect of impurities and additions upon the nucleation of voids during diffusion and the initiation of grain boundary cracks during creep, and the mechanism of crack nucleation by vacancy condensation is discussed. (auth)

5717 (NP-11166) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Frazier, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Nov. 1961. 64p.

A listing of selected documents and journal articles in abstracted form on high-strength alloys, light metals, nonmetallics, refractory metals, coatings, applications, and composites is presented. Author and subject indexes are included. (M.C.G.)

5718 (NP-11167) THE MELTING CURVES OF FIVE METALS UNDER HIGH PRESSURE. Technical Report No. 2. Marvin L. McDaniel, Stanley E. Babb, Jr., and Gene J. Scott (Oklahoma. Univ., Norman. Research Inst.). Oct. 1961. Contract Nonr-982(05). 22p.

A method for determining the melting curves of substances by utilizing internal heating in a pressure vessel, with an accuracy on the order of 0.1°C, is described. Using this method, the melting curves of Bi, In, Pb, Tl, and Sn were investigated. The data may be used to evaluate the constants in the Simon equation, and thus provide a means of checking theoretical predictions. (P.C.H.)

5719 (NP-11169) EXPLORATORY INVESTIGATION ON THE EFFECT OF URANIUM ADDITIONS TO MAGNESIUM AND SOME MAGNESIUM ALLOYS. B. Lagowski (Canada. Dept. of Mines and Technical Surveys. Mines Branch). June 5, 1961. 8p. (CURF-R-11; PM-R-61-16).

Uranium was added to magnesium and magnesium alloys containing Al, Zn, Zr, and Mn. It was found that the uranium additions to impure magnesium do not remove the impurities to the level obtained by the vacuum distillation process and, therefore, would not be useful for the refining of electrolytic magnesium. The uranium phase in pure magnesium, which is located predominantly at the grain boundaries, appears to be nonmetallic, and as shown by the pitting in normal metallographic preparations, dissolves readily in water. The addition of uranium to the alloys caused no change in microstructure, grain size, or tensile properties. It appears that the solubility of uranium in magnesium increases with higher zinc content. (P.C.H.)

5720 (NP-11178) INVESTIGATION OF REFRACTORY METAL BERYLLIDES AND SILICIDES AS VERY HIGH TEMPERATURE MATERIALS. Progress Report No. 8 [for period] July 1, 1961 to September 30, 1961. Jonathan Booker, Robert M. Paine, and A. James Stonehouse (Brush Beryllium Co., Cleveland). Nov. 10, 1961. Contract AF33(616)-6540. 38p.

The investigation of refractory metal beryllides and silicides for very high temperature (>2500°F) applications for short time use, 10 hours or less, was continued. Measurements to determine the impact, thermal shock, and oxidation resistance of Ta_2Be_{17} and WSi_2 in the intermediate temperature region are reported and discussed. Oxidation resistance measurements on Ta_2B2_{17} at 3000°F are reported also. Vapor pressure measurements by the Knudsen cell technique and oxidation rate determinations for $TaBe_{12}$, Ta_2Be_{17}, Zr_2Be_{17}, and $ZrBe_{13}$ are reported and discussed. The products of oxidation of Zr_2Be_{17} are discussed. Initial screening oxidation resistance measurements on beryllide–silicide ternarys are reported. (auth)

5721 (NP-11182) THE EFFECTS OF SIMULATED SPACE ENVIRONMENTS ON STRUCTURAL PLASTIC MATERIALS. J. Brownlee and J. P. McNally (Aerojet-General Corp., Azusa, Calif.). Aug. 1960. 42p. (SP-TP-24; RD-R60-80).

Glass fabric-reinforced plastic laminates can be used satisfactorily in space environments with integrated radiation dosages up to 10^{11} ergs per gram (C) as indicated by test results determined from gamma irradiation. It is also indicated that reinforced plastics can be expected to withstand mixed flux environments with equivalent energy transfer equally as well. Structural adhesives approved under MIL-A-8431 did not deteriorate below specification requirements with an integrated dosage of 10^{11} ergs per gram (C). Other materials that are equally resistant to nuclear radiation are alkyd-isocyanate foam sandwich structures and glass fiber-reinforced phenolic honeycomb cores. In addition to their radiation-resistance properties, the structural integrity of adhesive-bonded sandwich structures was proven in low-cost, high-efficiency construction in air vehicles. The Northrop T-38 supersonic trainer, for example, incorporates 25 percent of its wetted area in adhesive-bonded sandwich structure. The Convair B-58 Hustler uses adhesive-bonded or brazed sandwich structure in 90 percent of its wetted surface areas. Studies show that the heat-resistant materials are more resistant to degradation from nuclear radiation than the standard materials. This is particularly important for it implies that reinforced plastics research to obtain materials resistance to various types of energy exposures can be evaluated in preliminary studies by simple thermal energy exposures. In general, the combined space environmental conditions of radiation, high vacuum, meteoric dust, and temperatures within the range of −80 to +175°F will have no significant effect on the mechanical, thermal, and electrical properties of high-temperature-resistant reinforced structural plastic materials, during an exposure period in excess of one year. (auth)

5722 (NP-11194) SPACE ENVIRONMENTAL EFFECTS ON SEALS, GASKETS, ADHESIVES AND OTHER ELASTOMERIC AND POLYMERIC MATERIALS: AN ANNOTATED BIBLIOGRAPHY. Helen M. Abbott, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Sept. 1961. Contract AF04(647)-673. 220p. (SB-61-40).

Issued as an Addendum to the Space Materials Handbook.

This bibliography contains 558 selected references on seals, gaskets, adhesives, sealants, and other elastomeric and polymeric materials under space conditions. Environmental conditions that will effect materials in space are exposure to high vacuum, service temperatures, and radiation. Radiation includes ultraviolet and high-energy radiation as appropriate to the application of the material. Any application of adhesives in fabricating pressurized containers and attaching solar cell plates were included as were any tests conducted on materials used for seals and gaskets in contact with reactive fluids such as, hydrazine, UDMH (unsymmetrical dimethyl hydrazine), N_2O_4, and red fuming nitric acid. Materials used for inflatable space vehicles and structures are included as general applications of plastics or polymers. These references were compiled for the years 1951 to 1961. A material index is included as a possible aid in locating specific materials. (auth)

5723 (NRL-5702) CRACK PROPAGATION IN AIR AND IN VACUUM FOR NICKEL AND A NICKEL–CHROMIUM–ALUMINUM ALLOY. R. J. Sherman and M. R. Achter (Naval Research Lab., Washington, D. C.). Sept. 11, 1961. 9p.

Creep rates were measured for Ni at 1200°F in air and in vacuum and related to the depth of surface cracks in the specimens tested in the two environments. The surface cracks were observed to grow faster in air than in vacuum in both short-time and long-time tests. Crack depths, however, could be correlated with creep rates only in the short-time tests. Although no cracks were observed in a relatively brittle Ni–Cr–Al alloy creep tested at 1300°F, the appearance of alloy specimens fractured after interruption in creep indicated that there was a decrease of intergranular cohesion resulting from the diffusion of atmospheric gases into grain boundaries. (auth)

5724 (WADD-TR-60-184(Pt.II)) EFFECT OF BASIC PHYSICAL PARAMETERS ON ENGINEERING PROPERTIES OF INTERMETALLIC COMPOUNDS. J. H. Westbrook and D. L. Wood (General Electric Co. Research Lab., Schenectady, N. Y.). Mar. 31, 1961. Contract AF33(616)-6144. 63p.

The tensile behavior of the CsCl structure compound AgMg are extensively documented in terms of strain, strain rate, temperature, grain size, composition, and metallurgical processing treatment. Three regimes of deformation behavior are observed: low temperatures, intermediate temperatures, and high temperatures. In each of these regimes different deformation processes operate. Specific findings have practical as well as scientific import. Certain exploratory studies on other intermetallics are also reported. (auth)

5725 (WADD-TR-61-72(Vol.I)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME I. OBSERVATIONS BY ELECTRON MICROSCOPY OF DISLOCATIONS IN GRAPHITE. Richard Sprague (National Carbon Co. Research Lab., Parma, Ohio). Mar. 1961. Contract AF33(616)-6915. 27p.

The application of the electron microscope to the study of dislocations in graphite is described. Sample preparation is detailed. Photographs are shown illustrating the wide variety of dislocation patterns observed and some of the information obtained from them is discussed. (auth)

5726 (AEC-tr-4937) SURFACE TENSION OF METALS. M. G. Ramazanzade. Translated from Izvest. Vysshykh Ucheb. Zavedenii, Ser. Fiz., No. 1, 172-3(1959). 4p.

A method for calculating the surface tension of metals by use of thermal conductivity is presented. It is assumed that the surface tension of metals changes with variation in atomic volume, and it is concluded that $\lambda/\sigma = 10^{-4}$ B where σ is the coefficient of surface tension, and B is a constant depending on the group to which the metal belongs. (J.R.D.)

5727 (AEC-tr-4948) HYDROGEN POROSITY IN METALS WITH SPECIAL CONSIDERATION OF ALUMINUM AND ITS ALLOYS. C. E. Ransley and D. E. J. Talbot. Translated for Oak Ridge National Lab., Tenn. from Z. Metallk., 46: 328-37(1955). 44p. (Includes original, 10p.).

The diffusion capacity of H_2 was determined in solid Al, Cu, and Ni and in molten Al. The solubility of H_2 in molten Al and Duralumin alloys was determined by direct quenching. It was found that bubbles form readily when the internal H_2 pressure exceeds the external atmospheric pressure. Experiments were conducted to correlate the H_2 content with porosity of Al, and a mechanism is proposed for the porosity. (D.L.C.)

5728 (AEC-tr-4949) ALUMINUM AND GAS. II. BUBBLES AND PORES IN MALLEABLE MATERIALS. Hans Kostron. Translated for Oak Ridge National Lab., Tenn. from Z. Metallk., 43: 373-87(1952). 65p. (Includes original, 15p.).

The various types of voids in malleable material are discussed, and expansion and diffusion bubbles are distinguished. Conditions for the formation of bubbles are outlined. Free internal surfaces in the casting, the behavior of voids during forging, and the formation of voids during working of the malleable material are discussed. Theory is given for bubble and pore growths. Possible sources of hydrogen in the bubbles are discussed critically. The effects of various melt treatment methods on the gas content, suspended particles, and trace elements are summarized. Examples illustrating the formation of bubbles are given which uses aluminum alloys. (D.L.C.)

5729 (SCL-T-396) INVESTIGATIONS WITH ELECTROLYTICALLY PRODUCED AND TEMPERED ALUMINUM OXIDE FILMS BY MEANS OF ELECTRON INTERFERENCES AND IN THE ULTRAMICROSCOPE. Georg Hass and Helmut Kehler. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Kolloid-Z., 97: No. 1, 27-35(Oct. 1941). 19p.

With the aid of electron interferences and ultramicroscopic photographs, detailed investigations were carried out on the structure of thin electrolytically produced Al_2O_3 films that were treated at different temperatures. It was observed that such foils can be utilized as practically structureless carriers for interference and ultramicroscopic photographs, up to temperatures of 650°C, since these foils are constituted colloidally and one hour's tempering up to 650°C does not bring about any significant modification in their appearance. One hour's annealing at higher temperatures led to a strongly pronounced, concentrated, or condensed crystallization in the various layers or foils. The lattice constant of this cubically face-centered Al_2O_3 was 8.06A. (M.C.G.)

5730 THE CRYSTAL STRUCTURE OF THE INTERMETALLIC COMPOUND $ZrZn_{22}$. Sten Samson (California Inst. of Tech., Pasadena). Acta Cryst., 14: 1229-36(Dec. 1961).

A complete determination of the crystal structure of the binary intermetallic compound most rich in zinc, the ξ-phase, in the zirconium–zinc system was carried out with use of all intensity data obtainable from single crystal Weissenberg photographs taken with Cu Kα radiation. The composition of the completely ordered phase is $ZrZn_{22}$. The refinement of the structure was carried out by application of the method of least-squares. The space group is O_h^7- Fd3m with 184 atoms per unit cube. The edge of the cubic unit cell determined with use of powder samples was a_0 = 14.101 ± 0.002 Å. The truncated tetrahedron, the icosahedron, and the hexagonal prism are prominent coordination polyhedra in this structure. An analysis of these polyhedra reveals that the packing of atoms around the crystallographically different zinc atoms varies widely. (auth)

5731 THE CRYSTAL STRUCTURE OF $NbZn_2$. C. L. Vold (Naval Research Lab., Washington, D. C.). Acta Cryst., 14: 1289-90(Dec. 1961).

Crystals of $NbZn_2$ were prepared, and a single crystal of about 0.06 mm diameter was selected from the crushed product and examined by the Weissenberg and precession methods. The unit cell was hexagonal, Laue symmetry of D_{6h}, with $a_0 = 5.05$, $c_0 = 16.32$ Å. The intensities of the h0l reflections were measured with a proportional counter and Cu Kα radiation. Examination of the structure factors for the most intense reflections showed that the observed structure factors were smaller in magnitude than the corresponding calculated values. Of particular interest is the unusually short Zn–Zn distance, the shortest observed being a Zn_{II}–Zn_{II} distance of 2.45 Å. The data are tabulated. (P.C.H.)

5732 THE UNIT CELL OF U_2Ru. A. F. Berndt (Argonne National Lab., Ill.). Acta Cryst., 14: 1301-2(Dec. 1961). (ANL-FGF-250)

A melt containing 17.5 wt % Ru was prepared and Debye-Scherrer photographs were taken with Cu Kα radiation. The Laue symmetry was found to be C_{2h}. With the aid of approximate lattice parameters calculated from rotation and Weissenberg photographs, and the observed intensities, the strongest lines of the powder pattern were indexed. However, due to uncertainties in the intensities, only the preliminary stages of a structure were determined in order to arrive at an approximate structure. The data are tabulated. (P.C.H.)

5733 ELASTIC CONSTANTS OF LITHIUM–MAGNESIUM ALLOYS. J. Trivisonno and Charles S. Smith (Case Inst. of Tech., Cleveland). Acta Met., 9: 1064-71(Dec. 1961).

The single crystal elastic constants of dilute lithium–magnesium alloys were measured using the ultrasonic pulse-echo technique. In terms of d ln C/dx, all fundamental elastic constants increase with composition by the following amounts: C_{44}, 1.22; C′, 1.03; B_s, 1.20, per atom fraction. Small corrections for lattice parameter change upon alloying were made for C_{44} and C′ by using the pressure derivatives of the elastic constants of pure lithium and the known variation of the lattice constant with composition. The remaining effect is ascribed to alloying alone. Both to understand the elastic shear constants of lithium and to comprehend their dependence on composition, small negative stiffness contributions arising in the Fermi energy must be included, in addition to the major and usual electrostatic stiffness. It is then possible to deduce the variation with composition of each contribution from the measured total variation for the two shear constants, with the result that $d \ln C_E/dx = 1.24$ and $d \ln C_F/dx = 1.76$. (auth)

5734 THE RECRYSTALLIZATION DIAGRAM OF CAST TUNGSTEN. E. M. Savitskii, M. A. Tylkina, A. I. Pekarev, M. I. Gavrilyuk, and A. P. Zabavnova (Baikov Inst. of Metallurgy, Academy of Science, USSR). Doklady Akad. Nauk S.S.S.R., 140: 1301-3(Oct. 21, 1961). (In Russian)

Tungsten of technical purity (99.6% purity) was fused in a vacuum arc furnace, and was reduced by 70% by hot pressing and annealed for one hour at 1600°C in a hydrogen atmosphere in order to obtain a grain size of 40 to 50 μ. This starting material was deformed 6 to 90% by hammer forging in a hydrogen atmosphere at a temperature of 700 to 1100°C. These temperatures are below the recrystallization temperature. Each sample was then annealed for one hour at temperatures of 1000 to 2500°C at intervals of 100 degrees in an electrical resistance furnace in vacuum (1×10^{-6} mg Hg) and in hydrogen. Thin sections were electropolished in 10% NaOH at a current density of 1.7 amps/cm^2 in order to determine the microstructure and Vickers hardness at a 10 kg loading. A three-dimensional, recrystallization diagram is presented in which the average grain size is plotted as a function of the degree of reduction (from 0 to 90%) and of the annealing temperature (from 1400 to 2500°C). The initial recrystallization temperature occurs at 1450°C at reductions of 30 to 90%. The optimum annealing temperature for obtaining a fine-grained structure in cast tungsten of technical purity is 1500 to 1600°C for reductions of 50 to 90%. A tungsten single crystal 2.5 mm in diameter was prepared by electron-beam zone melting. It was found that the initial recrystallization temperature of the single crystal, which had been reduced by 70%, was 1100 to 1150°C, or 300 degrees lower than the initial recrystallization temperature of the technical-grade tungsten. (TTT)

5735 EFFECT OF COMBINED STRESS ON YIELD AND FRACTURE BEHAVIOR OF ZIRCALOY-2. R. L. Mehan (General Electric Co., Schenectady, N. Y.). J. Basic Eng., 83: 499-512(Dec. 1961).

The yielding and fracture characteristics of Zircaloy-2 as a function of stress state were investigated at room temperature through the medium of thin-walled cylindrical specimens under internal pressure and axial tension. Stress states from uniaxial longitudinal tension to uniaxial tangential tension were examined. Two tests at elevated temperature were performed at a single stress ratio. It was found that the fracture ductility lessened with increasing biaxiality. A minimum in ductility was found at balanced biaxial tension where the fracture ductility, as expressed by the effective strain, was 29 per cent. The yielding and plastic flow properties were found to be highly anisotropic. Two methods were used to express the plastic flow data: a graphical approach and a theoretical analysis based on a theory proposed by R. Hill, either one of which is suitable to express the flow properties of Zircaloy-2 under various states of combined stress. (auth)

5736 STUDY OF THE INTRODUCTION AND DIFFUSION OF RARE GASES IN METALS. Y. Adda, G. Brébec, and V. Lévy (Centre d'Etudes Nucleaires, Saclay, France). Mém. sci. rev. mét., 58: 743-56(Oct. 1961). (In French)

Various methods that can be used to introduce rare gases into metals are considered. The diffusion coefficients of the gas in the metal are determined by heating the rare-gas-saturated metals in vacuum and measuring the quantities of rare gas extracted. Precipitation of rare gas bubbles during heat treatments is also studied. (auth)

5737 X-RAY DATA FOR THE CHROME–URANIA SYSTEM, $Cr_2O_3 \cdot 2UO_3$. Deane K. Smith, Carl F. Cline, and Donald E. Sands (Univ. of California, Livermore). Nature, 192: 861-2(Dec. 2, 1961).

$Cr_2O_3 \cdot 2UO_3$ was prepared by mechanically mixing 78 wt % uranium oxide and 22 wt % chromium oxide, pressing the mixture into pellets and firing to 1250°C in platinum dishes. The samples were examined by chemical, optical, and x-ray techniques. The x-ray powder patterns indicated only one phase. Single-crystal photographs of two small crystals recovered from the preparations showed the crystals to be truly orthorhombic with three-fold interpenetrant twinning producing the pseudohexagonal habit. The twinned crystals produced a cockscomb effect around the periphery of the plates. The specific gravity of the crystals is greater than 3.3, which suggests either one molecule per unit cell with a calculated specific gravity of 4.18 or two molecules with a specific gravity of 8.36. The data are tabulated. (P.C.H.)

5738 BORAL—A SHIELDING MATERIAL FOR THERMAL NEUTRONS. O. Ruediger, J. Stickforth, and G. Lohrke (Fried. Krupp WIDIA-Fabrik, Essen). Tech. Mitt. Krupp, 19: 154-72(Nov. 1961). (In German)

Production and machining of Boral are described. The various attenuation laws applying to neutron fluxes with different distributions of neutron energy and direction, when boron carbide is distributed homogeneously are reviewed. The case of an inhomogeneous distribution of boron carbide is discussed theoretically by reducing it to a statistical problem similar to the Brownian movement. Formulas for neutron transmission are given in detail for three cases: monoenergetic neutrons, vertical incidence; thermal neutrons, vertical incidence; and thermal neutrons with an isotropic directional distribution. Neutron transmission measurements, which agree with the theoretical results, are described. (auth)

5739 EFFECT OF HEAT TREATMENT ON THE STRUCTURE, MECHANICAL PROPERTIES, AND CORROSION RESISTANCE OF HEAVY FORGED SECTIONS OF ZIRCALOY-2. John H. Schemel (Carborundum Metals Co., Akron, N. Y.). Trans. Met. Soc. AIME, 221: 1129-36(Dec. 1961).

Large Zircaloy-2 hammer or press forged bars did not exhibit the uniform excellent corrosion resistance to steam normally expected of the alloy in wrought form. Weight gains of coupons cut from forged bars were 40 to 60 mg per sq dm compared to the 28 mg per sq dm obtained on hot rolled sheet and strip. The mechanism of this corrosion and its relation to microstructure is discussed. After these observations, a solution heat treatment followed by rapid cooling was tried on coupons from eight heats of forged bars. The basket-weave structure resulting from the quench did not show agglomeration of intermetallic compounds. These coupons showed uniformly good corrosion resistance with weight gains very close to the 28 mg per sq dm expected of Zircaloy-2 after the 14-day steam test. A large forging was solution heat-treated and tested for structure, mechanical properties, and corrosion resistance. Corrosion resistance was excellent and uniform throughout the section. The normally anisotropic mechanical properties were changed to completely isotropic. Strength levels were raised while there was a small loss in ductility at the service temperature. Tempering of the quenched structure below the β transus did not improve the ductility at the test temperature of 600°F. (auth)

5740 X-RAY DIFFRACTION POWDER DATA OF U_6Fe. G. Katz and A. J. Jacobs (Israel Atomic Energy Commission, Rehovoth). Trans. Met. Soc. AIME, 221: 1273-4(Dec. 1961).

The U_6Fe sample was prepared with great care, and the x-ray-diffraction powder pattern was obtained with a Straumanis type Philips camera of 114.6 mm dia. Although Ni filtered Cu K_α (γ = 1.5418Å) radiation was used, no objectionable fluorescence was observed. Excellent agreement was found with other studies in the case of observed and calculated d-spacings, strongest reflections, and also reflections of lesser intensity. The data are tabulated. (P.C.H.)

5741 MAGNETIC NUCLEAR RESONANCE STUDIES ON METAL HYDRIDES. W. Spalthoff (Universität, Hamburg). Z. physik. Chem. (Frankfurt), 29: 258-76(Aug. 1961). (In German)

With a broad line apparatus whose permanent magnet gave 6007 gauss, the line width and displacement of the proton resonance in the powdered hydrides $ThH_{3.50}$, UH_3, $TiH_{1.98}$, $ZrH_{1.40}$, $TaH_{0.66}$, and $PdH_{0.63}$ were investigated in the temperature range from −190 to 300°C. The residence time of the hydrogen in the hydride lattice sites was calculated from the line width. The activation energy found for the exchange of places of hydrogen lies between 2.4 (palladium hydride) and 12.2 kcal/mole (zirconium hydride). The resonance displacement found in the paramagnetic uranium hydride amounts up to 100 gauss. It follows the Curie-Weiss law and can be traced back to a partial filling (2.57%) of the 1 $\underline{s}$ orbit of the hydrogen with an unpaired electron. The resonance displacement found in the usual hydrides lie under 1.5 gauss. (tr-auth)

5742 PHASE ANALYSIS OF HIGH-MELTING NICKEL ALLOYS. N. I. Blok, S. T. Kishkin, M. N. Kozlova, and N. F. Lashko. Zavodskaya Lab., 27: 1185-9(1961). (In Russian)

Interlayer phase analysis was made of high-melting Ni alloys by using various electrolytes. It is shown that the thin (0.05 mm) surface layer consists of oxides, the second layer of strongly alloyed solid-solution elements and oxides, and the deeper layer contains α' depleted alloys with a few oxides. (tr-auth)

5743 MELTING DIAGRAM OF Ti–Zr–Nb SYSTEM. V. S. Mikheev and O. K. Belousov. Zhur. Neorg. Khim., 6: 1905-8(Aug. 1961). (In Russian)

The melting diagram of Ti–Zr–Nb alloys is studied. The reaction between zirconium and titanium influences the solidus surface. A determination of the initial melting point permitted the selection of optimal compositions with high melting points. The results confirm a postulation on the presence of continuous solid solutions above the temperature of polymorphous transformation. (R.V.J.)

5744 CONSTITUTION DIAGRAM OF Ru–Cr ALLOYS. E. M. Savitskii, V. F. Terekhova, and N. A. Birun. Zhur. Neorg. Khim., 6: 1960-2(Aug. 1961). (In Russian)

The constitution diagram of Cr–Ru alloy has two peritectics: $l + \beta \rightleftharpoons \sigma$ at 1600° and $l + \sigma \rightleftharpoons$ at 1470°. At lower temperature the Cr-base solid solution and the σ phase form non-homogeneous Cr_3Ru. A two-phase region, $\sigma + \beta$, is found between the σ phase and the Ru-base solid solution. The diffusion of Cr into Ru does not exceed 30 wt % Cr and does not vary with temperature. The microstructure of an alloy with 90 wt % Ru is shown. In the β phase, the hardness decreases from 970 to ≈350 kg/mm^2 as the composition is changed from 90 to 70 wt % Ru. (R.V.J.)

5745 CONSTITUTION DIAGRAM OF Al–Re ALLOY. E. M. Savitskii, M. A. Tylkina, and K. B. Povarova (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 1962-5(Aug. 1961). (In Russian)

A method of alloying Al and Re is described and a peritectic constitution diagram is plotted for alloys with 13.6 to 86.3% Re. The microstructure of cost and annealed alloy is included. (R.V.J.)

5746 STABILITY OF β SOLID SOLUTION OF Ti–Cr ALLOYS. N. V. Ageev, O. G. Karpinskii, and L. A. Petrova. Zhur. Neorg. Khim., 6: 1976-8(Aug. 1961). (In Russian)

The stability of β-solid solutions and the disintegration mechanism of Ti–Cr alloys were studied at 100 to 400°C. (R.V.J.)

5747 ELECTROLYTIC SEPARATION AND CHEMICAL ANALYSIS OF β-TITANIUM IN VTZ-1 ALLOY. E. M. Zhilina and N. S. Dombrovskaya. Zhur. Priklad. Khim., 34: 2345-7(Oct. 1961). (In Russian)

An attempt was made for β-phase separation of titanium alloy, VTZ-1 containing 0.05% C, 0.13% Si, 4.9% Al, 1.38% Mo, 0.1% Fe, and 1.90% Cr. The chemical analysis of the separated β phase.showed that β-titanium is enriched with Mo and Cr while Al is concentrated in α-titanium. (R.V.J.)

5748 THE METAL PLUTONIUM. A. S. Coffinberry and W. N. Miner, eds. Chicago, The University of Chicago Press, 1961. 457p.

Thirty-five papers presented at the 1957 World Metallurgical Congress in Chicago are included. The volume is divided into three parts. The first part gives the early history of plutonium, follows the evolution of its extractive and physical metallurgy to its current status, and gives a conspectus of its future. The second part deals mainly with the physical metallurgy of plutonium and its alloys. The third part describes the applications of plutonium alloys and compounds as fuel in reactors; the importance of plutonium as nuclear fuel; the various ways in which it is used in the cores of nuclear reactors; and some design concepts for fuels and reactors based on materials containing plutonium. (N.W.R.)

5749 CONTROL ROD ALLOY CONTAINING NOBLE METAL ADDITIONS. Australian Patent 228,844. Oct. 16, 1958.

This patent relates in general to alloys suitable for use in the fabrication of control rods for neutronic reactors, and more specifically to silver base alloys suitable for such applications. The alloy consists of from 0.5 to about 1.5 weight percent of a noble metal selected from the group consisting of platinum, ruthenium, rhodium, osmium, and palladium, up to 10 weight percent of cadmium, from 2 weight percent to 20 weight percent indium, the balance being silver.

5750 METHOD OF SUPPRESSING UAl_4 FORMATION IN U–Al ALLOYS. Australian Patent 231,648. July 30, 1958.

A method is given for suppressing the formation of UAl_4 in uranium–aluminum alloys, thereby rendering these alloys more easily workable. The method comprises incorporating in the base alloy a Group Four element selected from the group consisting of Si, Ti, Ge, Zr, and Sn, the addition preferably being within the range of 0.5 to 20 atomic per cent.

Radiation Effects

Refer also to abstracts 5331 and 6210

5751 (AERE-R-3869) THE DEPENDENCE OF ABSORBED ENERGY ON THE ORIENTATION OF SOME SOLIDS IRRADIATED WITH LOW ENERGY GAMMA RAYS. C. G. Clayton and J. B. Whittaker (United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England). Oct. 1961. 22p.

The directional properties of solid state radiation detectors, in the energy region where the photoelectric effect predominates, was examined by considering the variation of energy absorbed in solids shaped as right rectangular prisms and right cylinders during rotation in a homogeneous unidirectional radiation field. The analysis was simplified by considering rotation about an axis in one of the principal directions of the solid and perpendicular to the direction of the beam. Results of the analysis are given along with their use. (J.R.D.)

5752 (ANL-6321) RADIATION DAMAGE RATES IN NUCLEAR REACTORS. I. THE ELECTRICAL RESISTANCE OF GRAPHITE OVER THE TEMPERATURE RANGE 8-90°C: INITIAL DAMAGE AND ITS TEMPERATURE COEFFICIENT. W. Primak and E. Edwards (Argonne National Lab., Ill.). Sept. 1961. Contract W-31-109-Eng-38. 28p.

The behavior of 0.125-in. spectroscopic graphite rods is shown to be variable beyond the variation of measurement. Statistical measures are given for the variability before and with irradiation. The linear regression of the reciprocal per cent change in resistance against the reciprocal exposure was determined from 25 to 90% change of electrical resistance. The linear regression of the above regression coefficients was determined for the range from 8 to 90°C. The number of specimens required to achieve a given accuracy in monitoring is calculated. Within the precision of the data, there is no evidence for departure from isothermal damaging, hence no positive evidence of radiation annealing at these temperatures and extents of damage. (auth)

5753 (APAE-107) EFFECT OF RADIATION DAMAGE ON SM-1, SM-1A AND PM-2A REACTOR VESSELS. D. W. McLaughlin, B. J. Rowekamp, R. A. Chittum, R. W. Kelleman, P. E. Bobe, E. F. Clancy, and J. R. Coombe (Alco Products, Inc., Schenectady, N. Y.). Oct. 14, 1961. Contract AT(30-1)-2639. 89p.

The status of the SM-1, SM-1A, and PM-2A reactor vessels is discussed with regard to effect of irradiation on nil-ductility transition temperature and the associated problem of brittle fracture. The three vessels are reported not subject to brittle fractures at present because of restrictions placed on operation during startup and shutdown. At temperatures where brittle fracture could occur, stresses were limited to 18% of the yield strength of the vessel material. Vessel stresses were limited by controlling the primary system pressure, cooling and heating rates and core power level. (auth)

5754 (CEA-1892) INFLUENCE DES DEFAUTS CREES PAR DES ELECTRONS DE GRANDE ENERGIE SUR LES CARACTERISTIQUES ELECTRIQUES DES JONCTIONS P-N. (The Influence of Defects Produced by High Energy Electrons on the Electrical Characteristics of p-n Junctions). L. Koch and N. Van Dong (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 6p.

The life-time of minority carriers in semiconductors is very sensitive to the presence of defects introduced by high-energy electrons. The formation of defects thus affects the short-circuiting current and the open circuit voltage of a p-n junction, these being dependent on the life-time. Several types of germanium and silicon junctions were bombarded with 2-Mev electrons from a Van de Graaf and with β-particles from radioactive sources. The experiments were carried out both at ordinary temperatures and that of liquid air. In this latter case an anomaly in the electron-volt effect was found: the short-circuiting current and the voltage in vacuo, after an initial decrease, increased again and exceeded their initial maximum value before once more decreasing. A qualitative interpretation of this abnormal effect is given. (auth)

5755 (DC-52-28-55) RADIATION DAMAGE TO REACTOR CONTROL SYSTEM COMPONENTS (TASK 1404). John L. Anderson (General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati). Aug. 13, 1952. Decl. July 18, 1961. 41p.

A survey of classified literature is presented on radiation damage to insulation, electronic components, elastomers, lubricants, and hydraulic systems used in reactor control systems. 29 references. (L.T.W.)

5756 (DP-579) MECHANICAL PROPERTIES OF IRRADIATED STAINLESS STEELS. A Compilation of Data in the Literature. Richard E. Schreiber (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1961. Contract AT(07-2)-1. 108p.

Changes in the mechanical properties of stainless steels that are caused by fast neutron irradiation are presented in graphic form. These data were abstracted from classified and unclassified reports published since 1948 by USAEC, AECL, and AERE. Data are included for the following stainless steels: AM-350, Boron stainless, 301, 302, 304, 305, 309(H-H), 316, 321, 322W, 329, 347, 410, 414, 420, 431, 440C, 442, 446, Armco 17-4PH (AMS5643), Armco 17-7PH, and Stainless W. The mechanical properties for which data are reported include hardness, yield strength, tensile strength, total elongation, reduction of area, elastic modulus, fatigue strength, notch factor, creep, stress relaxation, impact energy, and transition temperature. (auth)

5757 (DP-623) STRESS RELAXATION IN ZIRCALOY-2 DURING IRRADIATION AT LESS THAN 100°C. J. Walter Joseph, Jr. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1961. Contract AT(07-2)-1. 21p.

The relaxation of tensile stresses in specimens of Zircaloy-2 that were irradiated at a temperature below 100°C was compared with the stress relaxation in unirradiated control specimens that were held at the same temperature for the same length of time. Irradiation had no effect on the relaxation of initial stresses of 10,000 and 15,000 psi in annealed specimens. An initial stress of 25,000 psi in annealed specimens relaxed to 19,000 psi with irradiation and to 15,000 psi without irradiation. An initial stress of 15,000 psi in 10% cold-worked specimens relaxed to between 8,000 and 10,000 psi with irradiation and to 12,000 psi without irradiation. The radiation exposures, which were as high as 8×10^{20} fast neutrons per square centimeter, decreased the ductility and increased the strength of the specimens. (auth)

5758 (EURAEC-93) FIRST QUARTERLY REPORT ON THE EFFECT OF RADIATION ON THE DUCTILE-BRITTLE TRANSITION IN PRESSURE VESSEL STEELS. E. Anderson, W. Bollmann, D. King, M. Malone, and J. Spreadborough (Battelle Memorial Inst. International Div., Geneva). Apr. 25, 1961. Work performed under United States-Euratom Joint Research and Development Program. Contract [041-60-12RDS]. 88p.

Iron and binary alloys of iron containing a few % silicon, nickel, chromium, and manganese are to be studied initially; the reasons for this choice are discussed. The applications of the main techniques of investigation, tensile testing and electron microscopy, are described together with a brief outline of the subsidiary techniques of electrical resistivity, x-ray diffraction, and internal friction studies. Preliminary experiments to produce controlled grain sizes and methods of determining grain sizes are described and discussed. The progress made so far in the design and construction of special apparatus (furnaces and a low temperature cryostat) is recorded, and some results concerning the preparation techniques for electron microscope samples are given. The irradiation requirements are discussed and it is shown that the alloys chosen are satisfactory from the point of view of induced activity after irradiation and that the doses required will not lead to significant composition changes due to transmutation. It is also shown that the dimensions of the samples to be irradiated are such that no significant self-shielding effects are encountered. Finally, questions relating to dosimetry and control and manipulation in the reactor are considered. (auth)

5759 (HW-69403) IRRADIATION TESTING OF MGCR-HDR-1, 2, AND 3 IN THE DR-1 GAS LOOP. Topical Report. E. C. Bennett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 27, 1961. Contract AT(45-1)-1350. 19p.

Test fuel elements for the Maritime Gas Cooled Reactor program were irradiated in the DR-1 gas loop. Two of these test elements were of the semi-homogeneous type. The third was a heterogeneous, 19-rod bundle, on which tests are incomplete. The test run statistics are given. (auth)

5760 (IDO-16646) THE DESIGN, INSTALLATION, AND TESTING OF THE GAS-COOLED REACTOR UO_2 IRRADIATION EXPERIMENT AT THE NRTS. E. H. Porter (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Sept. 8, 1961. Contract AT(10-1)-205. 71p.

The fuel element prototype development and testing program for the gas-cooled power reactor is discussed. Each of the sixteen experiments carried out was a miniature reentrant gas loop type experiment. Fuel capsules containing normal or low enrichment UO_2 were irradiated at fuel can wall temperatures of 1300 and 1600°F. The capsule assembly consisted of three concentric "cans"; a fuel can containing the UO_2, a He-pressurized NaK-filled can for heat transfer, and a He-N_2-filled outer can functioning as a thermal barrier for control of fuel can temperature. Four gas tubes and seven thermocouple leads inside a $^3/_4$-inch O.D. conduit connected each capsule with the control instrumentation which simultaneously monitored and controlled fourteen experiments. Unique with the experiments is a specially designed packing gland for bringing gas and thermocouple leads out of the conduit, and a transistorized electric-topneumatic temperature monitoring system. The design problems and difficulties encountered during construction and after startup and their solutions are presented in detail. (auth)

5761 (NEPA-905) REPORT ON PLUTONIUM. Dorothy H. Fisher (Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn.). Feb. 25, 1949. Decl. July 18, 1961. Contract [W-33-08-ac-14801(16250)]. 86p.

A summary of the physical, chemical, and metallurgical properties of Pu is presented. X ray diffraction and nuclear data are included along with results of equilibrium studies with other elements and compounds. (J.R.D.)

5762 (NP-11193) RADIATION EFFECTS ON SOLAR CELLS AND GLASS. An Annotated Bibliography. Alfred A. Beltran and Eugene E. Graziano, comps. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Oct. 1961. Contract AF04(647)-673. 49p. (SB-61-58)

A selected list of 118 annotated references to literature regarding ionizing radiation effects on photovoltaic cells and on glasses of various compositions which might be considered for solar battery glass cover slides is given. The literature search covered the period, January 1948 to August 1961. Sources searched were: Applied Science and Technology Index, 1957-July 1961; Armed Services Technical Information Agency, Technical Abstract Bulletin, 1958-July 1961; Chemical Abstracts, 1946-1959; Engineering Index, 1957-July 1961; Nuclear Science Abstracts, 1948-1961; Radiation Effects Information Center Accession List, 1957-July 1961; Science Abstracts A and B, 1946-July 1961. (auth)

5763 (SCR-442) GAMMA-RAY PHOTOCONDUCTIVITY IN POLYETHYLENE, POLYSTYRENE, AND AN

EPOXY FORMULATION. S. E. Harrison and A. W. Snyder (Sandia Corp., Albuquerque, N. Mex.). Oct. 1961. Contract [AT(29-1)-789]. 17p.

Presented at Conference on Electrical Insulation, Sponsored by National Academy of Science—National Research Council, Pocono Manor, Pennsylvania, October 23, 24, and 25, 1961.

The photoconductivity properties of polyethylene, polystyrene, and an epoxy formulation have been measured by gamma-ray intensities in the range 1.0 rad (H_2O)/min to 3.0×10^5 rads (H_2O)/min. The source of gamma radiation has been the fission product inventory of reactor fuel elements. Measurements of the photoconductivities have been made at controlled temperatures. The observed dependence of photoconductivity on gamma-ray intensity at a given temperature in the insulating materials can be characterized to good approximation by one or more regions, within which conductivity (σ) is expressed as: $\sigma = A\dot{R}^{\delta}$ (ohm-cm)$^{-1}$, where $\dot{R}$ is the gamma-ray intensity, and A and δ are empirical constants. Theory and measurements of δ by others indicate a range of values, $0.50 \leq \delta \leq 1.00$. In this work a range of values, $0.00 \leq \delta \leq 1.00$, was observed. (auth)

5764 (SCR-450) REORDERING PROCESSES IN NEUTRON IRRADIATED P-TYPE GERMANIUM. H. J. Stein (Sandia Corp., Albuquerque, N. Mex.). Nov. 1961. Contract [AT(29-1)-789]. 11p.

Presented at American Physical Society, Monterey, California, March 1961.

The kinetics of reordering processes in pulse neutron irradiated p-type germanium were investigated. At 73°K, the conductivity and mobility were stable following the irradiation pulse. At 150°K, parts of two processes were observed: release of trapped minority carriers and increased in hole concentration. The results were consistent with an unstable donor defect which is doubly charged positive. Near 300°K, a third process was observed which decreased the hole concentration. (M.C.G.)

5765 (TID-14429) CHARACTERISTICS AND ANNEALING OF NEUTRON IRRADIATED PbTe. J. C. Corelli and D. M. Amorosi (Knolls Atomic Power Lab., Schenectady, N. Y.). [Nov. 24, 1961]. Contract [W-31-109-Eng-52]. 9p.

Presented at American Physical Society, Chicago, Nov. 24-25, 1961.

Changes in electric conductivity, σ, Hall coefficient, R_H, and Seebeck coefficient, S, after high flux reactor irradiation of n- and p-type PbTe are reported. The p-type PbTe sample was irradiated to total accumulated doses of 1.0×10^{19} n/cm^2 (fast) and 3.0×10^{20} n/cm^2 (thermal), and the n-type sample was irradiated to doses of 10×10^{19} cm^{-2} neutrons with energy greater than 1 Mev and thermal neutron doses of 10^{21} cm^{-2}. It was concluded that n-type PbTe is capable of retaining all of its basic semiconductor properties after reactor irradiations of 10^{20} n/cm^2 (fast) and 10^{21} n/cm^2 (thermal) as long as the temperature of the material during irradiation is above about 170°C. The same general conclusion applies to p-type PbTe irradiated to 10^{19} n/cm^2 (fast) and 3×10^{20} n/cm^2 (thermal) with the added provision that the temperature during irradiation need only be above 150°C. (P.C.H.)

5766 (CEA-tr-R-1400) PROCESSUS CINETIQUES DANS UNE SUBSTANCE IRRADIEE. (Kinetic Processes in Irradiated Substances). M. A. Mokul'skii. Translated into French from Vysokomolekulyarnye Soedineniya, 2: 119-29(1960). 34p. (Includes original, 11p.).

A theoretical treatment was given of previously proposed mechanisms for the acceleration of kinetic processes by irradiation. It is believed that the anomalously large number of "hot" atoms in the irradiated substance is the probable cause of the acceleration. The possible concentration of the "hot" atoms was estimated. The effects of temperature, stress, and radiation intensity on the rate of kinetic processes in mechanical stress relaxation were studied. Formulas were derived for the change in the time spectrum of relaxation, in the dynamic modulus, and in other properties of a body subjected to the action of a radiation field. (auth)

5767 THE BEHAVIOUR OF DISLOCATIONS IN NEUTRON-IRRADIATED ALUMINUM. W. R. Thomas and J. L. Whitton (Atomic Energy of Canada Ltd., Chalk River, Ont.). Acta Met., 9: 1075-6(Dec. 1961).

Observations were made on the difference in behavior of moving dislocations in irradiated and unirradiated aluminum foils. Two types of specimens were irradiated: a thinned foil mounted in an aluminum specimen holder and a sheet 0.001 thick, which was thinned after irradiation. The observations showed that the movement of the dislocations in both types of the irradiated aluminum was slow and jerky. This was in marked contrast with the movement observed in unirradiated aluminum foils which was usually so fast that it could be observed only by the slip traces which remained. On annealing the irradiated foil, no change in behavior was observed until a temperature of at least 200°C was reached when some unimpeded movement of dislocations occurred. The traces left by the moving dislocations in the irradiated material persisted for a much longer time than those in the unirradiated material. Certain conclusions are drawn from the observations. (P.C.H.)

5768 ON THE VARIATION OF THE ELECTRONIC PARAMAGNETIC RESONANCE SIGNAL OF γ-IRRADIATED GLYCINE. André Bottreau (Laboratoire d'Optique Ultrahertzienne, Faculté des Sciences, Bordeaux). Compt. rend., 253: 2341-2(Nov. 20, 1961). (In French)

The hyperfine spectra of powdered polycrystalline and monocrystalline glycine are compared, after γ irradiation to an integral dose of 4.2912 mr, at temperatures of −180 to 10°C. The effects of temperature and crystalline orientation are studied. (T.F.H.)

5769 HARDENING OF LITHIUM FLUORIDE CRYSTALS BY IRRADIATION. J. S. Nadeau and W. G. Johnston (General Electric Research Lab., Schenectady, N. Y.). J. Appl. Phys., 32: 2563-5(Dec. 1961).

The very soft, pure crystals of LiF that are commercially available were found unsuitable for some experimental work because they suffer accidental plastic deformation during cleavage and tend to split on (110) planes. Irradiation with gamma rays produces harder crystals that can be cleaved and handled without much damage. The radiation-induced hardening and the color centers produced by moderate irradiation can be completely removed by annealing for several hours at 450°C. (auth)

5770 ELECTRON SPIN RESONANCE IN IRRADIATED POLYTETRAFLUOROETHYLENE: TEMPERATURE DEPENDENCE OF THE SPECTRA. Naoyuki Tamura (Japanese Assn. for Radiation Research on Polymers, Tokyo). J. Phys. Soc. Japan, 16: 2338-9(Nov. 1961). (In English)

Temperature dependences of the spectral shape are examined. Relation between spectral changes and polymer properties and structures are discussed. A broadening of the line width in electron spin resonance is ascribed to the variation of anisotropic hyperfine splitting arising from the dipole-dipole interaction between unpaired electrons and fluorine nuclei. (L.N.N.)

5771 RADIATION DAMAGE IN WELL ORIENTED PYROLYTIC GRAPHITES. L. C. F. Blackman, G. Saunders, and A. R. Ubbelohde (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 78: 1048-55 (Nov. 15, 1961).

Graphite formed by cracking methane under various conditions was exposed to neutron irradiation. Changes in electronic properties were measured: after radiation damage by neutron doses of the order 10^{17} neutrons/cm^2, after mild annealing around 470°C, and after strong annealing at 2200°C and above. Effects of radiation damage are proportionately greatest in specimens whose properties are initially nearest to those of ideal graphite. Some discrimination can be made between the types of disorder originally present, and the disorder added by irradiation. Changes of thermoelectric power of graphite in the direction of the c axis show latent increases attributed to disorder frozen in until after mild annealing. (auth)

5772 DISSOLUTION AND CONTACT MELTING OF IRRADIATED CRYSTALS. I. G. Berzina, A. F. Naumov, and N. A. Savintsev (Tomsk Polytechnic Inst., USSR). Soviet Phys.-Cryst., 6: 366-8(Nov.-Dec. 1961).

Descriptions are given of experiments with crystals of NaCl, Bi, Cd, and Pb before and after exposure to x rays or slow neutrons. The rates of the processes are found to be structure-sensitive. (auth)

5773 DISORDERED REGIONS INDUCED IN n-TYPE GERMANIUM BY FAST NEUTRONS AT LIQUID-NITROGEN TEMPERATURE. N. Guyen Van Dong, Lydie Koch, and Guyen Dinh Tuong (Centre d'Etudes Nucléaires, Saclay, France). Trans. Faraday Soc., 57: 1968-73(Nov. 1961).

Germanium samples were irradiated by fast neutrons at 77°K. Measurements of resistivity and Hall coefficient were performed during the bombardment. The decrease of electron mobility in the range of low neutron dose is in agreement with a recently proposed defect model. It is found that the mean radius of disordered regions which are p-type is about 50 Å. Each of these regions is surrounded by a space-charge region of much greater size. The contribution of space-charge regions to the initial carrier removal rate is much more important than that due to isolated defects. (auth)

PHYSICS

General and Miscellaneous

5774 (LA-2618) LAGRANGIAN HYDRODYNAMIC COMPUTATIONS AND MOLECULAR MODELS OF MATTER. Garrett Birkhoff and Robert E. Lynch (Los Alamos Scientific Lab., N. Mex.). Sept. 1961. Contract W-7405-eng-36. 58p.

An analysis was made of the analogy between schemes for integrating the equations of motion of a compressible fluid, in Lagrangian coordinates, and molecular models of matter. Computation schemes involving one and two independent variables were considered, for flows with and without shocks. (auth)

5775 (LAMS-2624) ELECTROMAGNETIC SIGNAL FROM A BOMB BURST IN VACUO. B. R. Suydam (Los Alamos Scientific Lab., N. Mex.). June-Aug. 1959. Contract W-7405-Eng-36. 10p.

If a bomb is burst *in vacuo*, the prompt gamma rays will eject Compton recoil electrons from the case and thus produce a radial current. As this current will be spherically asymmetric, in general, an electromagnetic signal will be radiated. The magnitude of this signal was calculated. It was found to be substantially independent of the yield and probably detectable to a distance of 10^6 kilometers or more. (auth)

5776 (NP-11141) PROGRESS REPORT NO. 20 [ON ELECTROPHYSICS], APRIL 1, 1961–SEPTEMBER 30, 1961. Ernst Weber (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Contract AF18(600)-1505. 186p. (R-452.20-61)

Developments are reported in electromagnetics, plasma electrophysics and electronics, solid state and materials research, microwave circuits, network theory, and systems and control. (M.C.G.)

5777 (NP-11201) STUDY OF THE EDGE EMISSION OF CADMIUM SULPHIDE AND SILICON BOMBARDED BY ELECTRONS. Final Technical Report. First of October 1960–30 September 1961. (Laboratoire d'Infra-rouge Technique et Applique, Gif-sur-Yvette, France). Contract N 62558-2720. 18p.

Experiments were made to détermine whether or not the observed light emission could arise from a mechanism of direct return from the conduction band to the valence band. In order to determine this, the number of states present between the bottom of the conduction band and the center of the zone were calculated and compared to the number of electrons present at dynamic equilibrium in the conduction band. Preliminary calculations were made to estimate the mean penetration of electrons into the crystal, the energy absorbed in the region penetrated, and the number of carriers created in this region. From this result the carrier density required was determined. Discussion and an illustration are also given of a cryostat in which a crystal of cadmium sulfide may be observed at low temperatures. A description is also given of a selective amplifièr with synchronous detection, operating at about 800 cycles per second, for the study of emitted light. (P.C.H.)

5778 (SCTM-257-61(14)) THE INDUCTION OF ELECTRIC FIELD BETWEEN PARALLEL PLATES BY A TIME-VARYING MAGNETIC FIELD. T. R. Bates (Sandia Corp., Albuquerque, N. Mex.). Sept. 1961. Contract [AT(29-1)-789]. 15p.

Solutions of the stationary electric field between parallel conducting plates which enclose certain types of uniformly time-varying magnetic fields were obtained. One of the methods used to obtain these solutions suggests a way of synthesizing, for further study, designs of induction accelerators whose electric and magnetic fields are both known and are in fact both expressible in terms of the vector potential alone. (auth)

5779 (TID-14396) CERTAIN ELECTRICAL AND OPTICAL PROPERTIES OF A COLLOIDAL PHASE IN A SOLID. Final Report, Part II. B. R. Gossick (Arizona State Univ., Tempe). Oct. 1961. Contract AT(11-1)-715. 42p.

The effects of a dispersed colloidal phase of ellipsoidal particles (metal precipitates, disordered regions, and certain systems of dislocations) in a semiconductor on the dielectric constant, conductivity and optical absorption by free carriers are treated. The results showed that ellipsoids have a more striking effect on these properties than spheres. The optical extinction by ellipsoidal metal particles in an insulating medium was also calculated, and the results indicate that ellipsoidal particles might account for a variety of bands. (auth)

5780 (TID-14461) TECHNICAL PROGRESS REPORT [ON MOLECULAR STRUCTURES AND THERMODYNAMIC PROPERTIES OF FLUORINE-CONTAINING GASES], APRIL 1, 1961 THROUGH MARCH 31, 1962. E. L. Pace (Western Reserve Univ., Cleveland). Contract [AT(30-1)-824]. 4p.

The molecular structure and low temperature thermodynamic properties were studied for the following simple fluorine-containing gases: trifluorophosphine, silicon tetrafluoride, and thionyl fluoride. An adiabatic calorimeter for measuring the heat of recombination of free radicals generated by a Co^{60} source was designed. (M.C.G.)

5781 (UCRL-6630-T(Rev.)) QUANTIZED MAGNETIC FLUX AND THE NATURE OF ELECTRICAL CURRENTS. J. W. Zink (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 20, 1961. Contract W-7405-eng-48. 9p.

Recent experimental measurements revealed the quantization of magnetic flux which was predicted by London and Onsager. The quantized unit measured appeared to be hc/2e rather than hc/e as originally predicted. It is shown that the pairing of electrons is not necessary to explain the results of the experiments. The basic nature of electrical currents enters the problem and therefore is discussed in detail. (M.C.G.)

5782 (AD-257713) MEASUREMENT OF THE RELATIVE IONIZATION CROSS SECTIONS OF Zn, Te AND Te_2, AND OF THE DISSOCIATION ENERGY OF Te_2 BY MASS SPECTROMETRY. R. Colin (Brussels. [Université]). Translation of "Mesure des Sections Efficaces d'Ionisation Relatives de Zn, Te et Te_2 et de l'Energie de Dissociation de Te_2 par spectrometrie de masse." 10p.

The use of mass spectrometry for measurement of relative ionization cross sections of Zn, Te, and Te_2 in the evaporation of ZnTe and for determining the dissociation energy of Te_2 is discussed. It was found that $\sigma_{Zn} : \sigma_{Te} : \sigma_{Te_2} = 0.48 : 1 : 1.28$. The dissociation energy of Te_2 was calculated to be 50.5 ± 2 kcal/mole. (M.C.G.)

5783 (UCRL-Trans-699(L)) IONIZATION- AND CHARGE-EXCHANGE CROSS-SECTIONS OF HYDROGEN ATOMS AND IONS IN HYDROGEN AT KINETIC ENER-

GIES OF 9 TO 60 KEV (thesis). Fred Schwirzke (Karlsruhe, Germany. Technische Hochschule). Translated by Forrest S. Baker (Univ. of California Lawrence Radiation Lab., Livermore). 1959. 34p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 6999.

5784 (UCRL-Trans-760(L)) THE DEGENERACY OF THE ELECTRON GAS RESULTING FROM PAIR PRODUCTION. H. Koppe. Translated by Stephen G. Brush (Univ. of California Lawrence Radiation Lab., Livermore) from Ann. Physik (6), 2: 103-12(1948). 12p.

The effect of formation of electron-positron pairs on the equation of state of the electron gas is investigated, and expressions for the thermodynamic functions in easily obtainable limiting cases are derived. (auth)

5785 TWO SOLUBLE MODELS OF AN ANTIFERROMAGNETIC CHAIN. Elliott Leib, Theodore Schultz, and Daniel Mattis (Thomas J. Watson Research Center, Yorktown, N. Y.). Ann. Phys. (N. Y.), 16: 407-66(Dec. 1961).

Two genuinely quantum mechanical models for an antiferromagnetic linear chain with nearest neighbor interactions are constructed and solved exactly, in the sense that the ground state, all the elementary excitations and the free energy are found. A general formalism for calculating the instantaneous correlation between any two spins is developed and applied to the investigation of short- and long-range order. Both models show nonvanishing long-range order in the ground state for a range of values of a certain parameter λ which is analogous to an anisotropy parameter in the Heisenberg model. A detailed comparison with the Heisenberg model suggests that the latter has no long-range order in the isotropic case but finite long-range order for any finite amount of anisotropy. The unreliability of variational methods for determining long-range order is emphasized. It is also shown that for spin $\frac{1}{2}$ systems having rather general isotropic Heisenberg interactions favoring an antiferromagnetic ordering, the ground state is nondegenerate and there is no energy gap above the ground state in the energy spectrum of the total system. (auth)

5786 AXISYMMETRIC STAGNATION POINT FLOW IN MAGNETOHYDRODYNAMICS. W. I. Axford (Defence Research Telecommunications Establishment, Ottawa). Appl. Sci. Research, 9B: 213-29(1961). (In English)

A theoretical treatment is presented of the axisymmetric stagnation point problem in magnetohydrodynamics. Two distinct arrangements of the magnetic field are considered, with the lines of force lying in the plane of, and perpendicular to the streamlines, respectively. The boundary conditions are examined carefully and the solutions are completed by joining them to meaningful distributions of magnetic field in the solid region. Exact solutions can be obtained by numerical methods, but it is more illuminating to consider approximations valid for very large and very small diffusion numbers (ratio of kinematic viscosity to magnetic diffusivity). Distinct boundary layers of current and vorticity occur in these limiting cases, which can be treated separately. For flows with the first arrangement of the magnetic field, and in which the field does not vanish at infinity, it is deduced that the solution refers to a forward stagnation point when the Alfvén number is less than unity, and to a rear stagnation point when the Alfvén number exceeds unity. An interesting choking effect is found in flows with the second arrangement of the magnetic field when the diffusion number is small, and the Alfvén number exceeds unity; it is believed that this effect could be demonstrated in the laboratory. (auth)

5787 EXCITATION OF THE FLUORESCENCE OF HIGHLY DILUTED AQUEOUS SOLUTIONS OF AROMATIC COMPOUNDS BY MEANS OF X RAYS. K. Sommermeyer, W. Pruetz, and V. Birkwald (Universität, Freiburg i. B.). Atomkernenergie, 6: 445-51(Nov. 1961). (In German)

The reactions following immediately after absorption of ionizing radiation in water are of great importance in the radiochemistry of aqueous solutions. In order to elucidate these problems, the radioinduced fluorescence of aromatic compounds in water was investigated. (auth)

5788 RESULTS OF THE FIRST EXPERIMENTS WITH SMALL-POWER MAGNETOHYDRODYNAMIC GENERATORS. W. S. Brzozowski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Bull. acad. polon. sci., Ser. sci., tech., 9: 559-62(1961). (In English)

Results are presented of the first experiments on the direct conversion of heat to electricity by means of the magnetohydrodynamic generators. The experiments were performed during the winter of 1960/61. The plasma torch was chosen as a heat source and argon as a working gas. The first experiments were concerned with investigation of seeding effects on insulation and materials. (N.W.R.)

5789 CHARACTERISTIC ELECTRON ENERGY LOSS MEASUREMENTS AT LOW TEMPERATURES. E. M. Hoerl and J. A. Suddeth (National Bureau of Standards, Washington, D. C.). J. Appl. Phys., 32: 2521-5(Dec. 1961).

A method is described for the investigation of characteristic energy losses of electrons in solids at temperatures in the liquid helium and liquid hydrogen temperature range. This method was primarily developed for the investigation of thin films of solidified permanent gases, but it is also very suitable for the study at low temperatures of any substance, which is obtainable as a thin film. For the measurement of the energy losses itself, a very versatile electrostatic analyzer lens was constructed which allows the observation of electron diffraction patterns of the samples before and after energy loss measurements. First results are reported on thin films of solid oxygen and solid xenon. (auth)

5790 THEORY OF THE POTENTIAL WELL PRODUCED BY MULTIPACTING ELECTRONS. I. VERY LOW-PRESSURE REGIME. R. L. Ingraham (New Mexico State Univ., University Park). J. Appl. Phys., 32: 2553-8(Dec. 1961).

Electrons multipacting in an evacuated discharge tube produce an effective static potential well in which the positive ions can be contained. The theory of the positive ion behavior in this electron well in the very low pressure regime ($P \lessapprox 10^{-6}$ mm Hg) is developed. The electron potential well is expressed finally as a double numerical integral of complete elliptic integrals for the general field point; for on-axis points it reduces to a single numerical integral of irrational expressions. With the short tube and constant sheet velocity approximations, the well is parabolic; the corresponding ion harmonic vibration frequencies are calculated. For the rigorous well these parabolas are flattened in the central parts and steepened near the electrodes. A self-consistent calculation of the ion density is made using an individual particle description of the ion gas (appropriate to very low densities) which results in an inhomogeneous integral equation. The solutions describe ion distributions peaked in the middle of the tube. For comparison with experiment the deflection of an ion beam fired across the tube is worked out. (auth)

5791 MOMENTUM AND ENERGY OF WAVES. J. R. Pierce (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 32: 2580-4(Dec. 1961).

Elementary arguments of conservation of energy and momentum are used to derive expressions for what is termed the formal momentum, angular momentum, and energy of a plane wave in a moving medium. If E is the energy per unit length, p the momentum per unit length, q the angular momentum per unit length, v_f the phase velocity, and if the angular variation of a circulatory polarized wave is as exp $(-jn\theta)$, $p = E/v_f$, and $q = nE/\omega$. If E_0 is the energy per unit length observed moving with the medium, and then if the medium moves past the observer with a velocity u and the observer measures a phase velocity v_f, he observes an energy per unit length E, $E = E_0/(1 - u/v_f)$. When p, q, and E are not the physical momenta and energy, they lead to the correct power and force for sinusoidal sources moving with respect to the medium. (auth)

5792 MAGNETICALLY CONFINED COLD-CATHODE GAS DISCHARGES AT LOW PRESSURES. R. L. Jepsen (Varian Associates, Palto Alto, Calif.). J. Appl. Phys., 32: 2619-26(Dec. 1961).

A theory is developed which considers some effects of space charge in inverted and normal magnetrons and in Penning structures. Estimates are made of current flow and its dependence on voltage, magnetic field, electrode geometry, and pressure. It is shown that discharges of much greater intensity may be expected in normal magnetrons with filamentary cathodes than in inverted magnetrons with filamentary anodes. It is also shown that comparable maximum discharge intensities should be obtainable in Penning structures and in normal magnetrons. A scaling relation involving magnetic field and radial dimensions of the electrodes is obtained. (auth)

5793 A METHOD FOR MEASURING THE CONDUCTIVITY IN A HIGH ELECTRON DENSITY PLASMA. K. B. Persson (General Electric Research Lab., Schenectady, N. Y.). J. Appl. Phys., 32: 2631-40(Dec. 1961).

The interaction between the solenoidal electric field and a circular cylindrical plasma column is used as the basis for the design of a pulse-operated bridge suitable for transient measurements of the electrical conductivity in the high-electron density plasma. The solenoidal electric field is generated in a single layer solenoid with a special shield preventing the axial electric field from interacting with the plasma, thereby avoiding the electric polarization and associated effects. The time varying magnetic field generated by the solenoid and the induced electric field are then the only fields interacting with the plasma, and these fields penetrate essentially unperturbed into the plasma as long as the skin depth of the plasma is large in comparison with its radius. The upper limit for the measurable conductivity is determined by the skin depth of the plasma, while the lower limit is determined by the noise level in and the maximum allowed signal on the bridge. The maximum allowed signal on the bridge is either determined by the fact that the solenoidal electric field must be sufficiently small so it does not disturb the thermal state of the plasma to a measurable degree, or else that the amplitude of the electron cyclotron frequency corresponding to the amplitude of the time varying, but essentially uniform, magnetic field must be negligible in comparison with the electron collision frequency v_m so that nonlinear magnetic field effects are avoided. This makes the bridge most useful in the high pressure range $(v_m > \omega)$ where the ratio between the upper and lower limits for the measurable conductivity in a typical afterglow plasma can be approximated as $10^{13}p/\omega$, while the upper limit as determined by the skin depth is $10^{10}/\omega$ ohm^{-1} cm^{-1} for a plasma with 1 cm radius. A Gaussian-like pulse with a width of approximately 1 μsec is applied to the solenoids which are close to critically damped in the corresponding frequency range, resulting in a time resolution of less than $\frac{1}{3}$ of a μsec for the conductivity measurement. (auth)

5794 THERMIONIC PROPERTIES OF HfC. John H. Ingold (General Electric Vallecitos Atomic Lab., Pleasanton, Calif.). J. Appl. Phys., 32: 2651(Dec. 1961).

The thermionic emission properties of bulk HfC were measured at 1300 to 2100°K. The experimental apparatus, in addition to the external instrumentation, consisted of a plane diode with a copper collector and a hafnium carbide emitter. The saturation emission current was measured as a function of temperature with a constant voltage of 95 v applied to the collector, which was spaced about 1 mm from the emitter. An approximate least-squares fit to the experimental points gives a work function of 4 v and a Richardson constant of 40 amp/cm^2 deg^2. A Richardson plot of the experimental data is given. (P.C.H.)

5795 ON HYDROMAGNETIC WAVES OF FINITE AMPLITUDE IN A COLD PLASMA. P. G. Saffman (King's Coll., London). J. Fluid Mech., 11: 552-66(Dec. 1961).

The existence of steady, one-dimensional, finite-amplitude waves in a cold collision-free plasma is investigated for the case in which the plasma and the magnetic field are uniform far ahead of the wave. It is supposed that the magnetic field at infinity is inclined at an angle β to the direction normal to the plane of the waves $(0 \leq \beta \leq \frac{1}{2}\pi)$. It is shown that the problem is equivalent to determining the orbits of a particle in a uniformly rotating field of force. Two types of waves are found to exist for $\beta \neq 0$: solitary waves and quasi-shocks. In a quasi-shock, the plasma and magnetic field oscillate irregularly behind the wave front about mean values, which are different from the values ahead of the wave. The width of the wave front is of the order of the ion gyro-radius. The quasi-shocks resemble oblique magnetohydrodynamic shock-waves. For the case $\beta = 0$, only solitary waves exist. The stability of the waves is considered, and it is concluded that the quasi-shocks are stable but that the solitary waves for $\beta \neq 0$ are unstable. (auth)

5796 THE DISTORTION OF A MAGNETIC FIELD BY FLOW IN A SHOCK TUBE. M. D. Cowley (Univ. of Cambridge, Eng.). J. Fluid Mech., 11: 567-76(Dec. 1961).

The full magnetic field solution is developed for idealized boundary conditions. At a magnetic Reynolds number equal to 4 the distortion is found to be considerable, but the field is well represented by a solution correct to third order in magnetic Reynolds number. The axial field in a real shock-tube configuration was computed, and experimentally measured fields were found to agree reasonably with theory. (auth)

5797 A CRITERION FOR THE FREE CHARACTER OF FIELDS. Jan Lopuszanski (New York Univ., New York). J. Math. Phys., 2: 743-7(Nov.-Dec. 1961).

It is shown that a field is a free field as soon as the states generated by the Heisenberg field and the incoming field operators operating on the vacuum coincide. Conclusions are drawn from statement concerning the strong convergence of the field for t tending to infinity, the uselessness of the local clothed particle representation, and the diagonalization of the Hamiltonian, as well as the time behavior of the mathematical vacuum. (auth)

5798 SUPPORT OF A FIELD IN p SPACE. G. F. Dell'Antonio (Northwestern Univ., Evanston, Ill.). J. Math. Phys., 2: 759-66(Nov.-Dec. 1961).

The notion of generalized free field is introduced, as an obvious extension of a discrete superposition of independent free fields with different masses. The following assumptions are also made: there is an underlying Hilbert space $\mathcal{H}$ (positive-definite metric), the theory is Lorentz invariant, the vacuum belongs to $\mathcal{H}$ and is there unique, the spectrum of the energy-momentum operator is—apart from the origin—completely contained within the region $p^2 \geq e^2$, $p_0 > 0$. It is then shown that a necessary condition for a cyclic field to have support in p^2 only on a finite interval of the positive real axis, is that A(x) be a generalized free field. A similar result is derived under slightly weaker conditions. (auth)

5799 DYNAMICAL MAPPINGS OF DENSITY OPERATORS IN QUANTUM MECHANICS. Thomas F. Jordan and E. C. G. Sudarshan (Univ. of Rochester, N. Y.). J. Math. Phys., 2: 772-5(Nov.-Dec. 1961). (NYO-9555)

The most general dynamical law for a quantum mechanical system is studied with particular reference to the necessary and sufficient conditions for such a law to represent Hamiltonian dynamics. The main results are stated in the form of three theorems. (auth)

5800 NEW POSSITILITIES FOR A UNIFIED FIELD THEORY. W. Israel and R. Trollope (Univ. of Alberta, Edmonton, Can.). J. Math. Phys., 2: 777-86(Nov.-Dec. 1961).

The introduction of nonsymmetric g_{ik} in unified field theories of the Einstein-Schrōdinger type is open to the objection, on group-theoretical grounds, that the symmetric and antisymmetric parts transform independently. This objection does not apply to the use of nonsymmetric $\Gamma_{ik\mu}$, since these quantities are irreducible under the "extended group," consisting of the point transformations and the Einstein λ transformations. A theory based on symmetric g_{ik} and nonsymmetric $\Gamma_{ik\mu}$ is considered. The Lagrangian L is assumed to depend only on g_{ik} and the contracted curvature tensor R_{ik} (this insures the λ invariance and transposition invariance of the theory). For simplicity, it is supposed further that L involves R_{ik} rationally and, at most, quadratically. The resulting theory accounts for the main feature of gravitation, electromagnetism, and their interaction. In particular, the theory yields the correct equations of motion for charged masses. The electromagnetic tensor is associated with the skew part of R_{ik}, and the λ transformations correspond roughly to the gauge transformations of electrodynamics. (auth)

5801 PRINCIPLES OF LIMITING ABSORPTION AND LIMITING AMPLITUDE IN SCATTERING THEORY. I. SCHRÖDINGER'S EQUATION. Farouk M. Odeh (International Business Machines Corp., Yorktown Heights, N. Y.). J. Math. Phys., 2: 794-800(Nov.-Dec. 1961).

The outgoing solution of the time-independent Schrödinger equation, with a suitably restricted real potential, is shown to be the uniform limit of the square-integrable solutions of the same equation with complex energy as the imaginary part of the energy tends to zero. Under further restrictions on the potential, it is also shown that the solution to the initial-value problem for the time-dependent Schrödinger equation tends to the outgoing solution as time increases indefinitely. (auth)

5802 PRINCIPLES OF LIMITING ABSORPTION AND LIMITING AMPLITUDE IN SCATTERING THEORY. II. THE WAVE EQUATION IN AN INHOMOGENEOUS MEDIUM. Farouk M. Odeh (International Business Machines Corp., Yorktown Heights, N. Y.). J. Math. Phys., 2: 800-2 (Nov.-Dec. 1961).

It is assumed that the properties of such a medium will approach those of a homogeneous one as the space variable $\vec{r}$ approaches infinity. The wave velocity is assumed to be a function of $\vec{r}$ which tends to a certain constant as $r \to \infty$. Solutions of the reduced wave equation are characterized in a three-dimensional space. (L.N.N.)

5803 FOUNDATIONS FOR A TREATMENT OF THE SCATTERING OF LIGHT BY THE HYDRODYNAMICAL AND STATISTICAL ATOM MODEL. Masami Wakano (Princeton Univ., N. J.). J. Math. Phys., 2: 803-24(Nov.-Dec. 1961).

A study was conducted on the scattering of light by the hydrodynamical and statistical atom model. Bloch's treatment of the hydrodynamical equations of motion for this model is supplemented by inclusion of the interaction with the electromagnetic field. Attention is limited to oscillations of small amplitude. By correspondence principle arguments, general expressions were derived for the cross sections for absorption, coherent and incoherent scattering. The energy can be expressed—following Bloch—as the energy of a Thomas-Fermi atom plus a Hamiltonian which is associated with departures from the Thomas-Fermi distribution. Using Bloch's quantization of this Hamiltonian and applying the method of quantum field theory, the correspondence principle results for elementary cross sections was rederived. Applying the correspondence theoretical argument to the matrix element, Heisenberg's result for the total intensity of the Compton scattering was rederived. The method of stationary phase was applied to the hydrodynamical treatment; this method gives the same result as does the linear term in the momentum transfer in Heisenberg's expression, except for a numerical factor $3^{1/2}/2$—a point that was discussed by Bloch many years ago. Application of the general formulas given here for angular distribution of Rayleigh and Compton scattering will require electronic machine calculations of higher modes of oscillation of the gas model of the atom analogous to those made by Wheeler and Fireman for $l = 1$. (auth)

5804 SYMMETRIC EXPANSION OF ONE- AND TWO-CENTER COULOMB POTENTIALS. Peter R. Fontana (Univ. of Chicago). J. Math. Phys., 2: 825-8(Nov.-Dec. 1961).

A one-center expansion of the electrostatic interaction energy of a discrete charge distribution is developed by making use of the algebra of irreducible tensors. The result is completely symmetric in the coordinates of the particles, and the relative magnitude of the vectors need not be specified. It is shown that a suitable interaction representation provides useful formulas for electrostatic and quantum mechanical applications. In addition, some transformation equations make it possible to refer any arbitrary number of vectors to a second origin, thus yielding general two-center expansions for overlapping charge distributions. (auth)

5805 PROBABILITY DISTRIBUTION FOR CLASSICAL FLUIDS. A. A. Broyles (Univ. of Florida, Gainesville). J. Math. Phys., 2: 848-57(Nov.-Dec. 1961).

The probability distribution in phase space is obtained for particles in a small part of the total volume of a classical monatomic fluid in thermal equilibrium. It is shown that the distribution reduces to that obtained from a grand canonical ensemble as this part of the volume increases in size. The Debye-Huckel pair distribution function is obtained in the proper limit for the Coulomb case. The distribution is in the form of a first approximation with an infinite series of correction terms. (auth)

5806 ON THE EQUATIONS GOVERNING THE COHERENCE OF THE RADIATION EMITTED BY RANDOM CHARGE AND CURRENT DISTRIBUTIONS. M. Beran and G. Parrent, Jr. (Technical Operations, Inc., Arlington, Mass.). J. Opt. Soc. Am., 52: 98-9(Jan. 1962).

An extension of the coherence theory in the field of physical optics is given to include source terms and to provide the framework for using optical and microwave measurements to obtain information about the statistical current and charge correlations in an optically thin plasma. Differential equations relating the correlation tensor to the current and charge correlations are derived from Maxwell's equations. The correlation tensor is a statistical quantity defined as the ensemble average of the product of the field at different times and positions. The usefulness of the results stems from the consideration that at optical and microwave frequencies the correlation tensor of the E far field may be determined by interferrometric techniques. (P.C.H.)

5807 COLLOQUE SUR LA PHYSIQUE NUCLEAIRE AUX BASSES ET MOYENNES ÉNERGIES, À STRASBOURG, LES 23, 24 ET 25 MAI 1961 AU. (Conference on Nuclear Physics at Low and Medium Energies, Strasbourg, May 23, 24, and 25, 1961). J. phys. radium, 22: 529-728(Oct. 1961).

Sixty nine papers and six abstracts are presented from the conference. All 69 of the papers have been abstracted separately. All are in French. (T.F.H.)

5808 FLUCTUATIONS IN A PLASMA. I. ION-ELECTRON TEMPERATURE RELAXATION. Osamu Aono (Tokyo Univ.). J. Phys. Soc. Japan, 16: 2264-70(Nov. 1961). (In English)

Fluctuations of the electric field in a plasma are treated on the basis of the fluctuation-dissipation theorem. The treatment is applied to the relaxation between ion and electron temperatures. The interaction between ion and electron which causes the relaxation is reduced to the interaction between the ion and the fluctuating electric field caused by the surrounding electrons. The short range encounters between electrons are neglected but the long range encounters are included through the dielectric permeability which is obtained by use of the fluctuation-dissipation theorem. The rate of relaxation agrees with the result obtained by Kihara et al. who considered that the ion interacts with the individual electrons. (auth)

5809 ON THE SHOCK CONFIGURATION IN A PERFECTLY CONDUCTING GAS IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD. Shigeki Morioka (Ritumeikan Univ., Kyoto). J. Phys. Soc. Japan, 16: 2346-7(Nov. 1961). (In English)

If a two-dimensional body is placed in a steady, uniform flow of a perfectly conducting gas in the presence of a uniform magnetic field parallel to the flow, an attached or detached shock configuration must occur for certain values of the Mach number and the Alfven number at infinity upstream. The shock wave can be transformed into the shock polar. Mathematical relations are given, and the kind of configuration can thus be determined. New types of configurations are found and discussed. Results of calculations are presented in graphical form. (L.N.N.)

5810 ABSORPTION AT ELECTRON CYCLOTRON RESONANCE IN SLIGHTLY IONIZED GASES. [PART] I. Shigetoshi Tanaka. Mem. Coll. Sci., Univ. Kyoto, Ser. A, 29: 361-70(Sept. 1961). (In English)

An expression of the absorption at cyclotron resonance was derived by using the specific inductive capacity for the microwave propagating in a slightly ionized gas along the static magnetic field. It coincided with that derived by Brown et al. from the conductivity. It was shown that the cyclotron resonance occurs at $\omega = \omega_c$, the absorption curve is Lorentzian, and the half-width gives a direct measure of the collision frequency. Approximate expressions of ordinary refractive index and extinction coefficient for the right-handed and the left-handed circularly polarized waves were derived. (auth)

5811 ABSORPTION AT ELECTRON CYCLOTRON RESONANCE IN SLIGHTLY IONIZED GASES. [PART] II. Shigetoshi Tanaka. Mem. Coll. Sci., Univ. Kyoto, Ser. A, 29: 371-80 (Sept. 1961). (In English)

An expression of the absorption at cyclotron resonance was derived for the microwave propagating through a slightly ionized gas, transversally to the static magnetic field. It was shown that the resonance occurs at $\omega_c = \sqrt{\omega^2 - \omega_p^2 - \nu_c^2}$ instead of $\omega_c = \omega$ and the absorption curve is not Lorentzian and the half-width depends not only on collision frequency but also on electron density. Therefore, one can obtain both the electron density and the collision frequency from one measured resonance absorption curve. The same expression was derived by solving the Boltzmann transport equation for the distribution of electrons under the same circumstances. (auth)

5812 ABSORPTION AT ELECTRON CYCLOTRON RESONANCE IN SLIGHTLY IONIZED GASES. [PART] III. Shigetoshi Tanaka. Mem. Coll. Sci., Univ. Kyoto, Ser. A, 29: 381-94(Sept. 1961). (In English)

It was verified by measuring the loss in a slightly ionized gas ($\eta \lesssim 0.2$) that the absorption curve at electron cyclotron resonance for the hybrid wave ($k_0 \perp B$) is well represented by the expression which was previously derived. It was shown that the electron density and the collision frequency are determined from the resonance position and the half-width of one measured absorption curve. The collision probabilities in neon, argon, and helium plasmas were determined from the pressure dependence of the collision frequency which was somewhat larger than those reported by others. (auth)

5813 MICROWAVE CONDUCTIVITY OF BOUNDED PLASMA. Shigetoshi Tanaka. Mem. Coll. Sci., Univ. Kyoto, Ser. A, 29: 395-406(Sept. 1961). (In English)

An expression for microwave conductivity of bounded plasma was derived in the absence of magnetic field and then another similar expression in the presence of it, introducing the depolarization effect in each case. It was shown that this effect is to replace ω in specific inductive capacity for unbounded plasma by $\omega' = \omega\{1 - L(\omega_p/\omega)^2\}$. The results were as follows: plasma resonance occurs at $\omega = \sqrt{L}\,\omega_p$; and magnetoplasma resonance occurs at two positions of electron density at each magnetic field, both for the transversal wave ($k_0//B$) and for the hybrid wave ($k_0 \perp B$). (auth)

5814 ENVIRONMENTAL EFFECTS ON ATOMIC ENERGY LEVELS. J. Jortner (Hebrew Univ., Jerusalem) and C. A. Coulson. Mol. Phys., 4: 451-64(Nov. 1961).

Environmental effects on the ground-state charge distribution and on the different energy levels of a hydrogen atom are considered. The medium is represented by a continuous dielectric, and the effect of the polarization of this medium is computed, using both a simplified self-consistent-field variational treatment, and also a perturbation calculation. The dielectric effects of the medium are compared with similar results based on discrete molecular models, taking into account both dispersion and overlap-repulsion forces. The dielectric effects on the ground-state charge distribution are of the same order of magnitude as the effects due to dispersion forces. The dielectric effects on Rydberg-type electronic transitions lead to blue shifts. This conclusion is in agreement with some recent experimental results. (auth)

5815 DE HAAS-VAN ALPHEN EFFECT IN InBi. A. C. Thorsen and T. G. Berlincourt (Atomics International, Canoga Park, Calif.). Nature, 192: 959-60(Dec. 9, 1961).

The de Haas–van Alphen effect, or oscillatory dependence of magnetic susceptibility on magnetic field strength at low temperature, was applied in studies on the Fermi surfaces of semiconducting compounds. Observations are reported of de Haas-van Alphen oscillations in single crystals of InBi. The pertinent parameters for three periods are presented graphically. The effective mass for each period was determined from the temperature-dependence of the amplitude of the oscillations. It is apparent that the ranges of de Haas-van Alphen parameters in InBi are similar to those characteristics in pure polyvalent metals. (C.H.)

5816 THE MILNE PROBLEM WITH A POLYNOMIAL SOURCE. T. Auerbach (Eidgenössisches Institut für Reaktorforschung A. G., Würenlingen, Switzerland). Nuclear Sci. and Eng., 11: 452-3(Dec. 1961).

Closed expressions are derived for the emergent angular distribution and total flux in the Milne problem, with a neutron source of the form x^n. (T.F.H.)

5817 ON THE STRUCTURE OF LIQUID ^{4}He FROM THE ELASTIC SCATTERING OF NEUTRONS. S. Franchetti (Università, Florence). Nuovo cimento (10), 22: 374-94(Oct. 16, 1961). (In English)

The experimental angular dependence of the scattering of cold neutrons from liquid He^4 is compared with that calculated for an assembly of very small randomly oriented crystals. The result of this analysis, which constitutes in fact an evaluation of the amount of randomness, is utilized together with the value of the zero point energy, to determine the two basic parameters appearing in a model proposed for the liquid. This model is equivalent to a statistical description of the fundamental state eigenfunction for the atoms of the liquid, and as such it allows the radial distribution function to be calculated, thus permitting a check of the theory by comparison with the experimental radial distribution (from neutron scattering). (auth)

5818 MÖSSBAUER EFFECT MEASUREMENTS ON SUPERCONDUCTING INDIUM. P. P. Craig, R. D. Taylor, and D. E. Nagle (Los Alamos Scientific Lab., N. Mex.). Nuovo cimento (10), 22: 402-5(Oct. 16, 1961).

The amplitude and width of the Mössbauer resonance in Fe^{57} is measured for Fe^{57} as a very dilute impurity in metallic indium. The resonance amplitude is found to remain substantially unchanged in the temperature interval 0.35 to 4°K, showing that the Debye temperature of In increases by less than 3°K in this temperature range. As the source is cooled from 300 to 4°K the resonance amplitude increases by only 50% in contrast to the minimum of 500% calculated from the Debye-Waller factor. (auth)

5819 ELECTRICAL PROPERTIES OF ORGANIC INSULATING LIQUIDS CONTAINING FLUORESCENT SOLUTES. M. Darveniza (Univ. of Queensland) and H. Tropper. Proc. Phys. Soc. (London), 78: 854-68 (Nov. 15, 1961).

A new phenomenon is reported which is concerned with the excitation of fluorescent solutes in organic liquid dielectrics when high electric fields are applied. The characteristics of the emitted light are studied and related to the pre-breakdown conduction current and the electric strength. Dielectric liquids showing this effect are synthesized by dissolving known concentrations of fluorescent materials in simple organic liquids. These liquids have confirmed the experimental results obtained with more complex transformer oil. Also, experiments are described which show that even highly degassed liquids exhibit a pressure dependence of electric strength if brought into a state of super-saturation by applying tension to the liquid. (auth)

5820 MAGNETOTHERMAL MEASUREMENTS ON GADOLINIUM. L. F. Bates and A. J. Pacey (Univ. of Nottingham, Eng.). Proc. Phys. Soc. (London), 78: 878-82 (Nov. 15, 1961).

The small heat changes accompanying the magnetization of 99.9% pure gadolinium were measured on a rod specimen. The results are analysed, and the principal magnetization processes are identified. Domain wall movement which occurs in low fields is discussed in the light of a theory by Goodenough, and the coercivity which the theory predicts is found to agree fairly well with experiment. Comparison is made with earlier results for cobalt. (auth)

5821 EXCITATION OF HELIUM TO THE $(1s, 2p)^1P$ AND $(1s,3p)^1P$ STATES BY PROTON AND ALPHA PARTICLE IMPACT. R. J. Bell (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 78: 903-11(Nov. 15, 1961).

The distortion approximation is applied to the processes $H^+(\text{or } He^{2+}) + He(1s^2)^1S \rightarrow H^+(\text{or } He^{2+}) + He(1s,2p)^1P$ and $H^+(\text{or } He^{2+}) + He(1s^2)^1S \rightarrow H^+(\text{or } He^{2+}) + He(1s,3p)^1P$, cross sections being obtained for incident proton energies in the range 10 to 1000 kev and for incident alpha particle energies in the range 40 to 4000 kev. For proton impact the maxima cross sections are found to be 0.18 and $0.035\pi\alpha_0^2$, at 88 and 124 kev respectively; and for alpha particle impact they are found to be 0.61 and $0.101\pi\alpha_0^2$ at 511 and 935 kev respectively. (auth)

5822 POST-ARC TEMPERATURE DECAY. J. W. S. Allan, H. Edels, and D. Whittaker (Univ. of Liverpool). Proc. Phys. Soc. (London), 78: 948-57(Nov. 15, 1961).

A method is described for determining the inter-electrode gas temperature at any chosen time following the current interruption of an arc discharge, using a rotating mirror camera to measure the velocity of a shock wave passing through the gas. From a series of such measurements the rate of temperature decay may be found, and results are given for times between 100 μsec and 1 sec after interrupting arcs in air between carbon electrodes. The average rates of decay of the mean core temperature during 1 msec following current interruption were 1.5 deg μsec^{-1} for an 8 mm gap (10 to 40 A) and 2.8 deg μsec^{-1} for a 2 mm gap (40 A). The temperature decay subsequent to a 40 A arc was also calculated from a knowledge of the gas properties and with the assumptions of cylindrical symmetry and energy loss by thermal conduction only. (auth)

5823 DISTORTION APPROXIMATION TO CROSS SECTIONS FOR EXCITATION OF 1s-2p TRANSITION OF HYDROGENIC IONS BY BARE NUCLEI. D. R. Bates (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 78: 1080-1(Nov. 15, 1961).

The application of the distortion approximation to the study of the excitation of a target hydrogenic ion with a nuclear charge Z_te from the 1s to the 2p level by a projectile with nuclear charge Z_te, $A^{(Z_t-1)+}(1s) + B^{Z_p+} \rightarrow A^{(Z_t-1)+}(2p) + B^{Z_p+}$, is described. The cross section $Q_{1s,2p}$ is graphically shown for selected values of Z_t/Z_p over a range of values of $E_p/M_pZ_t^2$. The results show that the curves tend to a limit as Z_t/Z_p approaches infinity; they do so rather slowly at low energies. (N.W.R.)

5824 THE ATOMIC g VALUES OF SOME RARE-EARTH ATOMS. K. F. Smith and I. J. Spalding (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Roy. Soc. (London), A265: 133-40(Dec. 19, 1961).

The atomic g factors of several low-lying states in the ground multiplets of CeI, NdI, SmI, GdI, DyI, and ErI were measured by the atomic beam magnetic resonance technique. Intermediate coupling, relativistic, and diamagnetic corrections recently calculated are shown to give good agreement with the measured g values of Nd, Sm, Dy, and Er and it is concluded that the ground configurations of Dy I and Er I are $4f^{10}6s^2$ and $4f^{12}6s^2$, respectively. The Gd I results are consistent with fairly pure LS coupling between the 5d and 4f electrons and the Ce I measurements indicate a strong interaction between the ground state, which is probably $5d4f6s^2$, ^3H, and a low-lying state from another configuration such as $5d^24f6s$, ^5I. (auth)

5825 PREPARATION OF MONOCRYSTALS OF STRONTIUM TITANATE AND SOME DATA ON THEIR DIELECTRIC PROPERTIES. Yu. I. Gorina, A. M. Kashtanova, G. V. Maksimova, and G. I. Skanavi (Lebedev Inst. of Physics, Moscow). Soviet Phys.-Cryst., 6: 377-8(Nov.-Dec. 1961).

The method of preparing strontium titanate monocrystals from the double oxalate of strontium and titanium is described and some data on the dielectric properties are presented. The monocrystals are grown in a corundum furnace, using Verneuil's method. The dielectric permeability varied from 315 to 320 and did not depend on frequency; tangents of the angle of dielectric loss are less than 0.004 at sonic frequencies. At temperatures below 77°K a sharp rise in permeability is observed. The value of permeability remains practically constant at about 15,000 in the temperature range 3 to 4° higher than that of liquid helium. Hysteresis loops are not observed at room temperature or at 77°K. At 4.2°K, the monocrystals are characterized by a very narrow hysteresis loop without a sudden appearance of saturation. (N.W.R.)

5826 PLASMA SOURCE FOR HIGH VACUUM. B. P. Kononov and K. A. Sarksyan. Zhur. Tekh. Fiz., 31: 1294-7 (Nov. 1961). (In Russian)

Descriptions are given of an experimental installation for preparing plasma by mixing electron and ion beams in a vacuum system with a pressure drop. The prepared plasma density was 10^{12} to 10^{13} cm^{-3} in a container pumped to 2×10^{-5} mm mercury. (tr-auth)

5827 LOCALIZATION OF HIGH-CURRENT DISCHARGE BREAKDOWN BY TRANSVERSE MAGNETIC FIELD. N. A. Bobyrev and O. I. Fedyanin (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 31: 1309-16(Nov. 1961). (In Russian)

Experimental studies are made of the initial stage of electrodeless spherical discharge in a transverse magnetic field. It is shown that it is possible to localize the breakdown point by using relatively small, special-configuration fields. (tr-auth)

5828 INITIAL STAGE OF THE HIGHCURRENT ELECTRODELESS DISCHARGE. N. A. Bobyrev and O. I. Fedyanin (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 31: 1317-23(Nov. 1961). (In Russian)

The initial stage of strong-current induction discharge in hydrogen is investigated. The development of the discharge is separated into three stages: breakdown, current skinning due to alternating plasma conductivity, and the formation and motion of the current loop under the effects of its magnetic field. A detailed qualitative explanation is given for the observed phenomena. (tr-auth)

5829 LONG ARCS OF HIGH PRESSURE. E. S. Borovik, R. V. Mitin, and Yu. R. Knyasev. Zhur. Tekh. Fiz., 31: 1329-36(Nov. 1961). (In Russian)

A device developing long arcs (up to 8 cm) at 1 to 100 atm pressure is described. Arc stabilization is achieved by rotating the surrounding gas. The arc plasma temperature, calculated by equations for electric conductivity and energy balance, was 2.2×10^4 K° at a power consumption of 2×10^5 v/cm^3. (tr-auth)

5830 CALCULATIONS OF MERCURY ARC TEMPERATURE AND EXPERIMENTAL VERIFICATION. I. M. Belousova and D. B. Gurevich. Zhur. Tekh. Fiz., 31: 1337-43(Nov. 1961). (In Russian)

The Maecker method, based on the Evenbass-Heller equation, was used for calculating mercury arc discharge temperature and its distribution along the cross section. The discharge axis temperature was measured using the 5790 Å emission line, and the distribution along the cross section was measured using the 4916 Å line. Correlations of calculations and measurements confirm the Maecker method. (R.V.J.)

5831 ERRORS OF MODELLING BY USE OF VIBRATING CHARGED PROBE. K. I. Luk'yanov (Saratov State Univ., USSR). Zhur. Tekh. Fiz., 31: 1358-67(Nov. 1961). (In Russian)

The errors introduced by vibrating charged probes in modeling two-dimensional electrostatic fields by induced current are investigated. The probe oscillation amplitude, shape, dimensions, and the uniformity of the charge distribution in the probe are considered as well as heterogeneity of the field. The derived expressions are used for evaluating the errors. Factual numerical examples are analyzed. Electrode edge effects are not considered. (tr-auth)

5832 ON THE PLASMA WAVEGUIDE CORRELATION. S. S. Kalmykova (Khar'kov State Univ.). Zhur. Tekh. Fiz., 31: 1374-8(Nov. 1961). (In Russian)

Plasma with particle density of 10^8 to 10^{14} cm^{-3} slows electromagnetic waves from 3 m to 3 mm. However, charged particle energy losses are negligible as are the losses of high-frequency energy in radiowave propagation due to the low plasma density. Practical applications of plasma waveguides are complicated by the problem of high-frequency power injection. Studies are made of electromagnetic energy reflection by a semi-infinite plasma waveguide. (R.V.J.)

5833 GUGONIO'S ADIABATIC CURVE FOR MAGNETIC HYDRODYNAMICS. V. P. Demutskii (Khar'kov State Univ.). Zhur. Tekh. Fiz., 31: 1392-4(Nov. 1961). (In Russian)

The Gugonio adiabat curve and variables (p*,V) for producing rupture ($q > 0$) and energy absorption ($q < 0$) are analyzed postulating a weak magnetic field and low energy reactions. (R.V.J.)

5834 ADVANCES IN ELECTRONICS AND ELECTRON PHYSICS. VOLUME 15. L. Marton, ed. New York, Academic Press, 1961. 419p. $13.00.

A review is presented of the use of Cs atomic beams and other devices as time and frequency standards. The properties of two- and three-level masers of the atomic-beam, solid-state, and traveling-wave types are reviewed, as well as other quantum mechanical amplifiers. Experimental and theoretical studies of relaxation in low-temperature paramagnetic diluted salts are discussed, including investigations of the effects of temperature, paramagnetic energy levels, magnetic field strength, and salt concentration on the relaxation rate. An investigation is made of the techniques for generation, detection, transmission, total reflection, and measurement of millimeter (0.1 to 3 mm wavelength) waves. The electron distribution in the ionosphere is studied as regards its steady state properties, its mechanics, and techniques for its determination. The uses of autodyne circuits in the measurement of electron spin, nuclear spin, and nuclear quadrupole resonance spectra in paramagnetic materials are described. (T.F.H.)

Astrophysics and Cosmology

5835 (DI-82-0129) SYNCHROTRON RADIATION AS THE SOURCE OF THE POLARIZED DECIMETER RADIATION FROM JUPITER. David B. J. Chang (Boeing Scientific Research Labs., Seattle). 1962. 192p.

Thesis submitted to the California Inst. of Tech., Pasadena.

A Stokes parameter description is developed for synchrotron radiation from a group of ultrarelativistic electrons with any specified distribution of positions, energies, and directions of motion. This description is used to study the radiation from a shell of ultrarelativistic electrons trapped in a dipole field. It is found that the polarization observed for the 31 cm radiation from Jupiter could be obtained from such shells provided a large number of the electrons have relatively flat helices. The problem of obtaining high energy, flat-helix electrons in a planetary magnetic field is considered. In particular, the effects of large scale magnetic disturbances on trapped particles are studied by following the particle guiding center motions through a disturbance. The guiding center motions of relativistic particles are determined by using relativistically correct drift velocity expressions obtained by application of an asymptotic approximation method of Bogolyubov and Zubarev. It was found that these magnetic disturbances might lead to a high density of high energy, flat helix electrons; however, many disturbances are required for appreciable diffusion to occur. Magnetic activity at Jupiter must be very great if this type of mechanism is to provide the relatively flat helix electrons required for the decimeter radiation from Jupiter to be synchrotron radiation. (auth)

5836 (UCRL-6465) EQUATIONS OF STATE FOR EVOLUTION STUDIES OF SUPERNOVAE. William H. Grasberger and Joseph B. Yeaton (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 1961. Contract W-7405-Eng-48. 17p.

Tables of the energy, pressure, and chemical composition for a stellar mixture, originally a pure Fe^{56}, are presented as functions of temperature and density. They cover a range of conditions pertinent to the evolution of supernovae, involving the decomposition of iron into helium plus neutrons, and the later stage of decomposition of helium into neutrons and protons. Relativistic degeneracy of electrons is included in these calculations. (auth)

5837 NEUTRINO EMISSION PROCESSES, STELLAR EVOLUTION, AND SUPERNOVA. PART II. H. Y. Chiu (Inst. for Advanced Study, Princeton, N. J.). Ann. Phys. (N. Y.), 16: 321-45(Dec. 1961).

When the internal temperature of a star exceeds 1 BK (10^9°K) the evolution is very rapid. The time scale is around 3000 years. Energy dissipated by emission of neutrinos is several orders of magnitude higher than that by optical radiation. Neutrinos have exceedingly long mean free path ($\sim 10^{20}$ gram/cm^2) and they will escape as soon as they are produced. The star will contract to release gravitational energy to make up the energy lost to neutrinos and the internal temperature will rise to comply with the virial theorem. It is possible in this fast evolutionary phase, to neglect optical radiations all together as compared with the neutrino radiation. A set of structural equations is thus obtained. The envelope is replaced by boundary conditions. A simple model is constructed to illustrate our approach. (auth)

5838 COSMIC ELECTRICAL DISCHARGES OR "GOBS OF ANTI-MATTER." C. E. R. Bruce. Engineer, 212: 946-50(Dec. 8, 1961).

Several new developments of the electrical discharge theory are discussed, including the theoretical calculation of the energy radiated by radio-galaxies, which is in accord with estimates based on observations of the amount of energy radiated by Virgo A. The theory also leads to a quite definite argument against continuous creation, and also to the prediction that spiral nebulae should exist on a stellar, as well as a galactic scale, a prediction which is verified by reference to a work published forty-two years earlier at Lick Observatory. Indications are given of the suggestions which other theories have to offer for the phenomena discussed. (auth)

5839 THE GALACTIC RED SHIFT. A. Ward (Royal Coll. of Science and Tech., Glasgow). Nature, 192: 858 (Dec. 2, 1961).

Theories are presented on the interpretation of the galactic red shift observed by Hubble in the light coming from distant galaxies. Attempts are presently being made to observe the gravitational red shift using γ rays from iron-57 and the Mössbauer effect. The resolution using iron-57 is 6×10^{-13}. If the γ rays in these experiments were allowed to pass through a radiation field of similar quality and the same order in energy density as on the surface of the Sun, extending over a distance of about a meter, the red shift expected from Finlay-Freundlich's relation is about 1% of the resolution. Discussion is also given on attempts to test Finlay-Freundlich's relation. (P.C.H.)

Cosmic Radiation

5840 (AD-260876) COSMIC-RAY INVESTIGATIONS. Final Report. W. E. Hazen (Michigan. Univ., Ann Arbor). June 30, 1961. Contract Nonr-1224(07). 5p.

A summary of activities in cosmic-ray investigations are presented. In a set of experiments concerned with underground cosmic radiation, it was shown that the radiation is primarily mu-mesons in equilibrium with their electron secondaries. Mu-meson spin was determined and interactions and decay of mu-mesons in air were studied. In another set of experiments the lateral density distribution of electrons in air showers was observed along with the density of penetrating particles. No data are included. (J.R.D.)

5841 (AFCR-661) FORBUSH DECREASES, SEPTEMBER 1, 1956–DECEMBER 31, 1959. HOURLY AND QUARTER-HOURLY DIAGRAMS. Technical Note No. 5. Arne Eld Sandstroem (Uppsala Univ. Inst. of Physics). Mar. 30, 1961. Contract AF61(514)-1312. 63p.

A collection is given of tables and diagrams concerning Forbush decreases during the period Sept. 1, 1956, to Dec. 31, 1959. Bihourly diagrams of all C.R. storms recorded during this period were reproduced previously. Hourly and quarter-hourly values are presented for some of the most remarkable of these decreases. The simultaneity of certain characteristic details of C.R. storms, as registered by 8 separate instruments in Uppsala and Murchison Bay, is discussed. The ratios between the variations of the meson and nucleon components have been calculated for the Uppsala and Murchison Bay stations. Some conclusions are being drawn. The lapse of time between s.s.c : s and correlated Forbush decreases has been studied. (auth)

5842 COSMIC RAY EVIDENCE FOR A RING CURRENT. P. J. Kellogg and J. R. Winckler (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 66: 3991-4001 (Dec. 1961).

Observations show that low rigidity protons from solar flares are permitted entry at Minneapolis only during the main phase of magnetic storms. The measured energy is much below the normal Störmer cutoff at that time. A ring current responsible for the main storm field reduces the Störmer cosmic-ray cutoffs. The model of the ring chosen is actually an azimuthal current on the surface of a sphere with current intensity proportional to sin θ where θ = co-latitude. It is shown that this mathematical form permits great simplicity in the analysis and leads to essentially the same result as a diffuse ring corresponding to the actual trapped radiation. The magnetic moment of the ring required to produce the cutoff change can be provided by reasonable intensities of very low energy trapped radiation. It is shown that the cosmic-ray data permit one to evaluate both the moment (M′) and radius (R) of the ring, whereas the surface magnetic measurements determine only the quantity M'/R^3. Since observation shows that the cosmic-ray cutoffs return to normal during the main phase, it must be assumed that the ring shrinks inward so that the surface field is maintained negative. Cosmic-ray evidence concerning the presence of a permanent ring current is discussed. Such a ring is measured directly by satellites during quiet times. (auth)

5843 OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959. 2. THE CAPETOWN ANOMALY AND THE SHAPE OF THE OUTER BELT. Robert A. Hoffman (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 66: 4003-6(Dec. 1961).

Any particles affected by the Capetown magnetic anomaly do not have trajectories that would pass through the position of the experimentally observed minimum in the outer belt. Therefore, the minimum cannot be taken as evidence either for the effect of the anomaly on the trapped radiation or for support of the neutron albedo source for the outer zone electrons. (auth)

5844 COSMIC-RAY KNEE IN 1958. H. V. Neher (California Inst. of Tech., Pasadena). J. Geophys. Research, 66: 4007-12(Dec. 1961).

During the International Geophysical Year, two series of balloon flights were made. One sampled the ionization due to cosmic rays over the range of geomagnetic latitudes from 38 to 87°N. The other covered the range from 13°N to 79°S. In each case similar balloon flights from a base station were made to make possible an allowance for changes in the primary radiation. The second series of flights is used to determine the location of the knee of the latitude curve at atmospheric depths from 10 to 220 g cm^{-2}. Results indicate that at this time of the solar cycle the knee moved toward the pole with decreasing amount of air overhead, reaching a geomagnetic latitude of 55° at 10 g cm^{-2}. This movement of the knee becomes very slow at the lower pressures, however, suggesting that even at much lower pressures, the knee would not move appreciably farther toward the pole. (auth)

5845 THE MAGNETIC FIELD OF A MODEL RADIATION BELT, NUMERICALLY COMPUTED. Shun-Ichi Akasofu (Univ. of Alaska, College), Joseph C. Cain, and Sydney Chapman. J. Geophys. Research, 66: 4013-26(Dec. 1961).

The magnetic field of a model ring-current belt encircling the earth symmetrically is numerically calculated, to a first approximation, for a particular model belt discussed by S. I. Akasofu and S. Chapman (J. Geophys. Research 66, 1321(1961)). The first approximation to the field only for points in the equatorial plane were calculated. The whole distribution of the field is here discussed, and for a particular intensity of the belt the calculation is carried to a second approximation. It is shown that over the earth's surface the field of the ring current is nearly uniform, though in auroral latitudes the diamagnetism of the belt produces an insignificant irregularity in the field disturbance. The model belt considered here is one whose center line is connected with the auroral zone by the dipole field lines of force; its particles were not observed directly. Its existence is suggested by the quiet-day anomaly of the satellite-observed magnetic field at that distance. The known Van Allen radiation belts seem likely to contribute little to the ring current field, but during magnetic storms the radius of the belt mainly responsible for this field is probably less than 6 earth radii. (auth)

5846 SOLAR PROTON IMPACT ZONES. Thomas Kelsall (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Research, 66: 4047-70(Dec. 1961).

The trajectories of charged particles moving in a magnetic dipole field were calculated by numerical integration for application to data on the intensity variation of cosmic rays during recent solar events. All seasons and times of day were covered by assuming a range of orientations of the incident particle beam with respect to the magnetic dipole axis. The points of impact with the earth were determined for protons with energies from 0.05 to 50 Bev. The computation includes 4000 trajectories and fills gaps in previous investigations. In agreement with earlier calculations the results indicate that the protons strike in well-defined areas between 0 and 1200 hours local time, and are focused into small areas of impact at low energies. The investigation revealed two points that are not new but received relatively little attention in earlier work. First, the relative number of impacts in the northern and southern geomagnetic hemispheres is strongly dependent on season. Second, under certain conditions of season there is a class of trajectories, which may be called quasi-trapped, constituting a set of paths resembling the trapped trajectories first discovered by Störmer but connected to infinity. It is suggested that injection into trapped orbits from these quasi-trapped trajectories may make a contribution to the population of the Van Allen belts. (auth)

5847 A STUDY OF THE ENHANCED IONIZATION PRODUCED BY SOLAR PROTONS DURING A POLAR CAP ABSORPTION EVENT. G. C. Reid (Defence Research Telecommunications Establishment, Ottawa). J. Geophys. Research, 66: 4071-85(Dec. 1961).

Polar-cap absorption of radio waves was shown to be caused by an influx of fast particles emitted by the sun at the time of certain solar flares. The steady-state day and night electron-density profiles produced in the lower ionosphere by such a particle flux are calculated, on the assumptions that the particles are protons and that their differential energy spectrum is of the form $n(E)\, dE = KE^{-5}\, dE$, with a sharp cutoff at the low-energy end. The shapes of the profiles are shown to be almost independent of the proton spectrum and low-energy cutoff, provided the latter is higher than about 10 Mev. The radio-wave absorption this ionization would produce is calculated for frequencies of 30 and 60 Mc/s. Conditions during the twilight transition period are also examined, assuming that O_2^- is the only negative ion present. The photodetachment coefficient of O_2^- is calculated as a function of solar zenith angle, and corresponding electron-density profiles deduced. By comparing the absorption these profiles would produce with the observed variation of cosmic noise absorption during twilight, it is shown that the presence of O_2^- alone is insufficient to account for the observations. (auth)

5848 BURSTS OF CENTIMETER-WAVE EMISSION AND THE REGION OF ORIGIN OF X RAYS FROM SOLAR FLARES. M. R. Kundu (Univ. of Michigan, Ann Arbor). J. Geophys. Research, 66: 4308-12(Dec. 1961).

Solar radio bursts were observed in different meter- and centimeter-wave frequency ranges, simultaneously with x-rays directly measured using balloons and rockets. It is shown that solar-flare x-ray bursts are intimately associated with centimeter-wave bursts from the sun while the relation with type III bursts is much more loose. There is strong evidence that flare x-rays of energy >20 kev are generated in the region of origin of emission of centimeter bursts, i.e., within about 10^4 to 2×10^4 km above the photosphere. (L.N.N.)

5849 ELECTRON TEMPERATURE MEASUREMENTS ON THE EXPLORER VIII SATELLITE. G. P. Serbu, R. E. Bourdeau, and J. L. Donley (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Research, 66: 4313-15(Dec. 1961).

The Explorer VIII electron temperature experiment is a simple modification of the classic Langmuir probe in that a grid and a collector are used. Observations are presented in graphical and tabular form. An uncertainty related to electron transparency of the grid contained in the sensor is within experimental error. The model of the diurnal variation of electron temperatures in the upper ionosphere is in close agreement with reference atmospheres obtained from satellite drag observations. The detailed time variation is consistent with the concept of heat loss by conduction downward after sunset and with photo-ionization as the predominant heat input keeping the temperature fairly constant in the late afternoon. (L.N.N.)

5850 NUCLEAR INTERACTIONS PRODUCED BY HEAVY NUCLEI OF PRIMARY COSMIC RADIATION IN NUCLEAR EMULSIONS. Yoshihiro Tsuzuki (Kobe Univ., Japan). J. Phys. Soc. Japan, 16: 2131-9(Nov. 1961). (In English)

Fifty-two nuclear interactions produced by the nuclei of cosmic radiation with charge Z = 6, 7, and 8, and with energies at $\sim 4 \times 10^{10}$ ev/nucleon were studied in nuclear emulsions. The ratio of the number of interactions with heavy nuclei (Ag and Br) to that with light nuclei (H, C, N, and O) was found to be 1.03, which is in good agreement with the value calculated by assuming the geometrical cross sections of the colliding nuclei. The features of interactions in which the colliding volume of an incident nucleus was equal to that of an alpha-particle were similar to those of a free alpha-particle. The average number of heavily ionizing tracks, N_h, indicated the exponential increase as the impact parameter decreased. The distribution of the total charge of the fragments showed rather regular bumps at even charge. Almost all shower particles ejected with the smallest angles to the primary direction (shower axis) were the nucleons which came from primary nuclei. The angular distribution of mesonic shower particles was nearly isotropic in the C. M. system at these energies. (auth)

5851 COSMIC RAY OBSERVATIONS AT 42 m w.e. UNDERGROUND AT HOBART, TASMANIA. A. G. Fenton, R. M. Jacklyn, and R. B. Taylor (Univ. of Tasmania, Hobart). Nuovo cimento (10), 22: 285-95(Oct. 16, 1961). (In English)

A cosmic ray observatory and associated recording equipment located at 42 m water equivalent underground are described. The average primary proton energy corresponding to this depth is about 300 Bev. Data from two large vertical meson telescopes are used to determine the atmospheric correction coefficients, and the results are compared with calculated values. The observed coefficients are: total barometer coefficient = $-(0.655 \pm 0.042)\%/\text{cm}$ (95% fiducial limits); partial barometer coefficient = $-(0.591 \pm 0.044)\%/\text{cm}$; negative temperature coefficient = $-(0.459 \pm 0.250)\%/\text{km}$; positive temperature coefficient = $+(0.020 \pm 0.010)\%/{}^\circ\text{C}$; and positive 3-fold temperature coefficient = $+(0.028 \pm 0.009)\%/{}^\circ\text{C}$. The low value for the positive temperature coefficient suggests that the attenuation length for π-mesons in the upper atmosphere is at least 125 g cm^{-2}. The effect on the underground intensity of a large change in the water content of the soil above the recorder is discussed. (auth)

5852 ON THE MOMENTUM SPECTRUM OF COSMIC-RAY MUONS AT SEA LEVEL. A. L. Rodgers (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 78: 918-25(Nov. 15, 1961).

The Manchester spectrum of muons arriving vertically at sea level is discussed in terms of the processes leading to the formation of the sea-level hard component of cosmic radiation. Evidence is presented to show that above a momentum of 20 Gev/c there are particles, probably muons, at sea level which cannot be explained in terms of π-μ decay only. (auth)

5853 SEA-LEVEL COSMIC RAY SPECTRA AT LARGE ZENITH ANGLES. J. E. Allen and A. J. Apostolakis (Univ. of Durham, Eng.). Proc. Roy. Soc. (London), A265: 117-32(Dec. 19, 1961).

Measurements were made at Durham (200 ft above sea level) with an emulsion spectrograph of the absolute cosmic ray particle intensity in the momentum range 1 to 100 Bev/c at zenith angles of between 65 and 85°. It is found that a differential π-meson production spectrum of the form $I_0E^{-\gamma}$ fits closely the present results as well as the accepted vertical spectrum. The values of the parameters when E lies between 6 and 1000 Bev are given by the equations $I_0 = 0.425 - 0.125 \log_{10} E$ and $\gamma = 3.92 - 0.944(1 - 0.125 \log_{10} E)^{-1}$ and their approximate constant values in this range are 0.15 and 2.55, respectively. The analysis is based on a previous model but, in addition, the effects of scattering and geomagnetic deflection of μ-mesons in the atmosphere were taken into account as well as their production over a range of atmospheric depths. Although in principle it should be possible from the form of the sea-level spectra at large zenith angles to determine the relative numbers of π- and K-mesons at production, it is shown that very great accuracy is required in order to do so. Nevertheless, the agreement between the theoretical curves and the experimental measurements indicates that the main assumptions concerning the production and propagation of mesons in the atmosphere are correct. The mean positive to negative ratio is 1.39 ± 0.08, a value rather larger than is found by other observers at 68°, but within statistical fluctuation. (auth)

Criticality Studies

5854 (APEX-311) CRITICAL EXPERIMENTS WITH THE HTRE NO. 1 NUCLEAR MOCKUP (TRA). R. E. Kerkhoff (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 14, 1957. Decl. June 9, 1961. Contracts AF33(038)-21102 and AT(11-1)-171. 84p.

A summary of the information obtained during the critical experiments at GE-ANPD for a direct-cycle aircraft-propulsion reactor is given. Permanent equipment and configuration are described. Results of studies of loading, rod calibration, reactivity, and power mapping, which were made during the critical experiments, are presented, as well as studies of the reflector, shield, and moderator.(auth)

5855 (HW-67240) MINUTES OF CRITICAL MASS LABORATORY PROGRAM MEETING, RICHLAND, WASHINGTON, OCTOBER 25-26, 1960. E. D. Clayton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 31, 1960. Contract AT(45-1)-1350. 40p.

The minutes are presented of a meeting to review the program planned for the Hanford Plutonium Critical Mass Laboratory. The laboratory is described and the experimental program to be carried is outlined. A review is also presented of current efforts at other sites. (M.C.G.)

5856 (WAPD-T-1404) THE USE OF MOCK-UP CRITICAL EXPERIMENTAL RESULTS IN THE NUCLEAR DESIGN OF POWER REACTORS. R. T. Bayard (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1961. Contract AT(11-1)-Gen-14. 11p.

Presented at ANS Meeting, November 1961.

The nuclear mock-up and its uses in the design of power reactors are discussed. The different types of mock-ups are described. The kinds of information obtainable from a mock-up include critical reactor configuration, spatial activation distribution, parameter measurements, and quantities not readily amenable to calculation. The ways in which mock-up information is used are discussed. (M.C.G.)

5857 (WCAP-1409) FEASIBILITY REPORT FOR THE MULTI-REGION LATTICE STUDIES CRITICAL EXPERIMENTS FUEL. D. F. Hanlen and P. W. Davison (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Jan. 27, 1960. Contract [AT(30-1)-2176]. 8p.

Fuel handling in conjunction with the receipt and experimental usage of the critical experiments multi-region fuel is discussed. Aspects of the operation are examined in sections on use of the nuclear materials, storage nuclear safety, hazards, materials control, responsibilities, and security. (J.R.D.)

5858 (XDC-57-6-129) ANALYSIS OF SM-I, SM-II-2 AND SM-II-5 CRITICAL EXPERIMENTS. Florence Silverstein (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 16, 1957. Decl. June 9, 1961. 42p.

Three configurations (SM-I, SM-II-2, SM-II-5) of the Solid Moderator Reactor were analyzed for the purpose of correlating theory with experiment on criticality, critical mass, gross radial power distribution, fine radial power distribution, and activation flux sensors. A method of determining the bare equivalent diameter is described for reactors having only a side reflector. Results of using first-order perturbation theory for determining the worth of off-center holes and boral strips are given. Satisfactory correlation between theory and experiment was obtained with ANP design procedures when the U^{238} in the fuel, a more recent value of $\nu = 2.46$, and improved thermal averaging of cross sections were taken into account. (auth)

Elementary Particles and Radiations

5859 (JINR-P-699) ZAMECHANIYA K VOPROSY OB ODNOMEZONNYKH VZAIMODEISTVIYAKH. (Remarks on Single-Meson Interactions). I. M. Gramenitskii, M. I. Podgoretskii, and O. A. Khrustalev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 25p.

In addition to theoretical studies of multimeson diagrams, a program is suggested for experimental studies of two interrelated moments in order to determine under what conditions it is possible to expect an increased importance of single-meson interactions. The resolution of problems is sought by studying N-N interactions. The cross section as a function of energy is plotted from calculations based on a single-meson scheme at various Δ^2_{max}. The maximum kinetic energy of nucleon recoil and a curve calculated without Δ^2 cut-off are given, as well as the cross section of N-N interaction as a function of energy assuming $\sigma_{\pi p} =$ const. The spectrum of recoil neutrons in $p + p \rightarrow p + n + \pi^+$ reaction at 970 Mev and the minimum possible neutron recoil pulse as a function of nucleon kinetic energy are plotted. (R.V.J.)

5860 (JINR-P-771) ELEKTRICHESKAYA I MAGNITNAYA POLYARIZUEMOST NUKLONOV I π-MEZONOV. (Electric and Magnetic Polarization of Nucleons and π Mesons). V. S. Barashenkov and G. Yu. Kaizer (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 54p.

An analysis is made of the theoretical and experimental data on electric and magnetic nucleon polarization. The electric and magnetic polarization of nucleons in experiments with γ quanta, cross sections of γ elastic scattering on protons, and neutron electric polarization in scattering experiments with slow neutrons are analyzed as well as the electric and magnetic polarization of π mesons. (R.V.J.)

5861 (JINR-P-772) GENERATSIYA CHASTITS PRI OCHEN BOL'SHIKH ENERGIYAKH. (Particle Production of High Energies). V. S. Barashenkov and V. M. Mal'tsev (Joint Inst. for Nuclear Research, Dubina, U.S.S.R. Lab. of Theoretical Physics). 1961. 16p.

Estimates were obtained for intensities of different particles, including γ quanta, neutrinos, and muons, produced by inelastic particle interactions in the energy region 1 to 10^3 Bev. These estimates may prove useful in designing high energy accelerators. (auth)

5862 (JINR-P-789) NEUPRUGIE VZAIMODEISTVIYA π^--MEZONOV S IMPUL'SOM 6, 8 Bev/s s NUKLONAMI. (Inelastic Interactions of π^--Mesons with Nucleons at 6.8 Bev/s Pulses). N. G. Birger, Kang-ch'ang Wang, Ts'u-tseng Wang, Ta'ts'ao Ting, Yu. V. Katyshev, E. N. Kladnitskaya, D. K. Kopylova, V. B. Lyubimov, Dinh'tu Nguen, A. V. Nikitin, M. I. Podgoretskii, M. I. Solov'ev, and Z. Trka (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. · Lab. of High Energy). 1961. 30p.

Studies were made of 355 π^--N events and secondary particle distributions were measured. Data on π^0 production were analyzed and the results are compared with the statistical theory. The existence of peripheral interactions is postulated, and the importance of the single-meson peripheral interactions is stressed for low multiplicity events (2-ray events) while multi-meson interactions (where central interactions are possible) are of importance in high multiplicity events. (tr-auth)

5863 (NP-11203) LECTURES ON RELATIVISTIC WAVE EQUATIONS. Physics Monographs No. IX. J. Leite Lopes (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). [1961]. 105p.

Part of lectures given at 1959 Latin American School of Physics, University of Mexico.

The relativistic wave equations for describing elementary particles are discussed. The representations of the three-dimensional rotation group and of Lorentz group are given. The equations of motion of free elementary particles were obtained from the study of the invariants of the latter group. The mass and spin were introduced into the theory and shown to be a consequence of relativity. (M.C.G.)

5864 (UCRL-Trans-759) ASYMMETRY IN THE ANGULAR DISTRIBUTION OF NEUTRONS DURING THE μ-MESON CAPTURE IN CALCIUM. V. S. Evseev, V. I. Komarov, V. Z. Kush, V. S. Roganov, V. A. Chernogorova, and M. M. Shimchak (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). Translated by Marie Kassatkin (Univ. of California Lawrence Radiation Lab., Berkeley) from report JINR-P-759. 1961. 32p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 31501.

5865 COMPLEX POTENTIAL MODEL FOR LOW-ENERGY NEUTRON SCATTERING. Harry Fiedeldey and Wilhelm E. Frahn (Univ. of Stellenbosch, Cape Province, South Africa). Ann. Phys. (N. Y.), 16: 387-406(Dec. 1961).

The optical model for low-energy neutron scattering is treated explicitly by means of a new form of complex potential which permits an exact solution of the S-wave Schrödinger equation. This potential is everywhere continuously differentiable and its imaginary part consists of both a volume and a surface absorption term which is in close agreement with recent theoretical calculations of the spatial distribution of the imaginary potential. Closed-form expressions are obtained for the logarithmic derivative of the wave function, and hence for the S-wave strength function and scattering length, from which their dependence on all potential parameters can be studied explicitly. It is shown that concentrating the absorption in the nuclear surface can serve as a remedy for a well-known discrepancy, by lowering the minima of the strength function to more realistic values. (auth)

5866 DETERMINATION OF THE PHASE SHIFTS IN THE SCATTERING OF POLARIZED PROTONS FROM A TARGET OF POLARIZED PROTONS. J. Raynal (Centre d'Études Nucléaires, Saclay, France). J. phys. radium, 22: 560-3(Oct. 1961). (In French)

Four parameters closely related to the spin-correlation coefficients can be measured, by proton-proton scattering in which both beam and target are polarized. At low energies, only S, P, and D waves give a contribution. The cross section, by itself, gives four solutions for all the values assumed for S and D in a given range. The behavior of each parameter thus measured is studied for each solution. Means are also studied for selecting the correct S and D phase shifts by the simplest possible measurements. (auth)

5867 MEASUREMENT OF THE POLARIZATION OF PROTONS ELASTICALLY SCATTERED FROM C^{12} IN THE VICINITY OF 5 Mev. S. Gorodetzky, J. Ullman, G. Bergdolt, and A. Gallmann (Institut de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: 570-2(Oct. 1961). (In French)

The polarization of protons elastically scattered from carbon at 48° in the laboratory system is measured by using a second scattering from carbon as an analyzer. The results show polarization of 0.66 ± 0.03, 1.01 ± 0.04, and 0.70 ± 0.03 at incident energies of 4.56, 5.01, and 5.49 Mev respectively. (auth)

5868 ELASTIC SCATTERING OF PROTONS WITH ENERGIES BETWEEN 1 AND 2 Mev BY N^{14}, P^{31}, AND Ar^{40}. J. Cohen-Ganouna, M. Lambert, and J. Schmouker (Ecole Polytechnique, Paris). J. phys. radium, 22: 592-7(Oct. 1961). (In French)

The differential cross section of elastic scattering at several angles, and angular distributions for different energies were measured. A gaseous scattering chamber with differential pumping is described. (auth)

5869 ELASTIC SCATTERING OF 11.85-Mev DEUTERONS BY Al, Si, P, AND S. G. Demortier and P. C. Macq (Université, Louvain, Belg.). J. phys. radium, 22: 597-601(Oct. 1961). (In French)

The angular distributions of elastically scattered 11.85-Mev deuterons on Al^{27} and of 11.5-Mev deuterons on Si^{28}, P^{31}, and S^{32} were measured, between 15 and 152.5°. (auth)

5870 ELASTIC SCATTERING OF NUCLEONS BY THE LIGHT NUCLEI D, He, AND C, AND COMPARISON WITH NUCLEON-NUCLEON SCATTERING. Richard Wilson (Harvard Univ., Cambridge, Mass.). J. phys. radium, 22: 610-14(Oct. 1961). (In French)

The impulse approximation enables the scattering amplitude for the scattering of nucleons by light nuclei to be expressed in terms of the nucleon-nucleon scattering matrix and the nuclear form factors. Experimental data for elastic scattering from D, He, and C at small angles is shown to be in accord with these predictions. The nuclear radius found by small-angle nucleon scattering is different for the real, imaginary, and spin-orbit parts of the scattering, and is larger than that found in electron scattering. The increase is due to the range of nuclear forces as exhibited in the nucleon-nucleon scattering matrix. (auth)

5871 PROTON-PROTON SCATTERING AT 155 Mev. C. Caverzasio, K. Kuroda, and A. Michalowicz (Laboratoire de Physique Nucléaire, Orsay, France). J. phys. radium, 22: 628-31(Oct. 1961). (In French)

Measurements of the proton-proton differential scattering cross section at 155 Mev are made within the angular range 8 to 90° C. M., using a liquid hydrogen target. Results are consistent with measurements made with a CH_2 target between 30 and 110° C. M. (auth)

5872 STUDY OF THE BREMSSTRAHLUNG FROM SCATTERED ELECTRONS IN THE CASE OF NUCLEAR EXCITATION. J. Perez y Jorba (Faculté des Sciences, Bordeaux). J. phys. radium, 22: 733-4(Oct. 1961). (In French)

The differential cross sections for the scattering of high-energy electrons by nuclei are derived, taking into account bremsstrahlung emission from the electrons and the possibility that the scattering process might excite the target nuclei. (T.F.H.)

5873 BREAKUP OF DEUTERONS BY THE REACTIONS H(d,p)pn WITH E_d = 18 Mev AND D(p,p)pn WITH E_p = 9 Mev. Keigo Nisimura (Tokyo Univ.). J. Phys. Soc. Japan, 16: 2097-2100(Nov. 1961). (In English)

The energy spectra of protons from the reactions H(d,p)pn with E_d = 18 Mev and D(p,p)pn with E_p = 9 Mev were measured as a function of angle. After conversion to the c.m. system, the shapes of the spectra were examined in connection with pair interaction between nucleons in the final state. The differential cross section of protons emitted by the reaction $p + d \rightarrow p + p + n$ has a minimum at about 120° similar to the cross section of p + d elastic scattering. (auth)

5874 RELATIVISTIC DYNAMICAL THEORY OF ELECTRON DIFFRACTION. Kunio Fujiwara (Tokyo Univ.). J. Phys. Soc. Japan, 16: 2226-38(Nov. 1961). (In English)

Multiple elastic scattering of electrons by crystals is considered based on the Dirac's wave equation with the perturbation method. The result shows that besides the usual relativistic correction for wave-length, a new correction factor appears in the intensity formula of reflection, corresponding to the mass correction of the electron. The new correction factor plays an important role in the dynamical theory of electron diffraction, and, for instance, it brings about an essential modification in the nonrelativistic result concerning the dependence of the reflection intensity on wave-length. It follows that the dynamical effect does not vanish at the limit $\lambda \rightarrow 0$. (auth)

5875 ON CHAMBERS' SOLUTION OF THE BOLTZMANN TRANSPORT EQUATION. Hideo Suzuki (Nagoya Univ., Japan). J. Phys. Soc. Japan, 16: 2347-8(Nov. 1961). (In English)

The generality of Chambers' "kinetic" argument is disclosed from the first principle. It is shown to be an exact solution of the Boltzmann transport equation. (L.N.N.)

5876 ON SINGLE-STRANGE MESONS. W. Królikowski (Inst. for Advanced Study, Princeton, N. J.). Nuclear Phys., 28: 81-3(1961). (In English)

Reactions are pointed out in which single-strange mesons proposed previously (W. Królikowski, Nuclear Physics 26: 91(1961)) could be observed. (auth)

5877 ELECTROMAGNETIC INTERACTIONS OF CHARGED PIONS. Bibhuti Bhusan Deo (Ravenshaw Coll., Cuttack, India). Nuclear Phys., 28: 122-34(1961). (In English)

Perturbation calculation results of electromagnetic effects involving charged mesons are reported. The pionic vacuum contribution to photon-photon scattering and Delbrück forward scattering are discussed in detail. (auth)

5878 ON MASSES AND MASS-SHIFTS OF ELEMENTARY PARTICLES. Bibhuti Bhusan Deo (Ravenshaw Coll., Cuttack, India). Nuclear Phys., 28: 135-9(1961). (In English)

Solutions were obtained for two interacting fields, the interaction being a simple product of the two fields operators. It is found that the interacting fields are equivalent to two non-interacting fields of different masses. This is true both for bosons and fermions. The possibility of formation of a massive Fermi particle from interacting neutrinos is also discussed. (auth)

5879 HIGHER RESONANCES IN PION-NUCLEON REACTIONS AND THE ISOBAR MODEL. Yukio Tomozawa (Univ. Coll., London). Nuclear Phys., 28: 160-71(1961). (In English)

Higher resonances in the pion–nucleon reaction are investigated using an isobar model. Introduction of the isobar approximation enables relation of the scattering and one-pion production processes to pion-isobar scattering to be determined, which is calculated in the Chew-Low static approximation. Neglecting the crossing terms (except in the Born term), and if the pion-isobar interaction is sufficiently strong, resonances in pion-isobar scattering in the four states $(T, J) = (1/2, 1/2), (3/2, 5/2), (5/2, 3/2)$, and $(5/2, 5/2)$ are obtained. The first two of these might give resonances in pion-nucleon reactions. Since the model requires positive parity states, they are $p_{1/2}$ for $T = 1/2$ and $f_{5/2}$ for $T = 3/2$. Comparison with experiments and discussion of Wong and Ross's approximation are presented. (auth)

5880 ON THE EXPERIMENTAL EVIDENCE FOR PION-PION INTERACTION IN HIGH-ENERGY π-N AND N-N EVENTS. P. Surányi (Central Research Inst. of Physics, Budapest). Nuovo cimento (10), 22: 40-50(Oct. 1, 1961). (In English)

It is assumed that the pion cloud plays the most essential role in very high energy π-N and N-N interactions. This is checked by comparing consequences of it with experimental data in the Bev region. (auth)

5881 K-MESON FORM FACTOR IN THE BIPION APPROXIMATION. Ph. Salin (Faculté des Sciences, Bordeaux). Nuovo cimento (10), 22: 51-65(Oct. 1, 1961). (In English)

The meson (K) form factor is calculated by applying the two-π model, taking into account the two-K intermediate state. A resonating form for π-π scattering in the I = 1, J = 1 state is assumed to dominate $K\bar{K}$ scattering such that there exists a pole in the $K\bar{K}$ matrix element for $t = t_r$. A Breit-Wigner form is obtained, and coupling constants are evaluated. The integral equation for the dispersion relations is solved and evaluated, and numerical results are presented. (L.N.N.)

5882 TRANSFER OF NEGATIVE MUONS TO GASES DISSOLVED IN A HYDROGEN BUBBLE CHAMBER. M. Schiff (Univ. of Chicago). Nuovo cimento (10), 22: 66-91 (Oct. 1, 1961). (In English)

The transfer reactions $(\mu^-H) + X \rightarrow (\mu^-X) + H$, where H = p or d and X = Ne or He, were studied by observing variations in the fractions of μ^- undergoing nuclear capture or catalyzing the fusion process $p + d \rightarrow He^3$. In deuterium-free hydrogen with a neon contamination of $(105^{+50}_{-23}) \cdot 10^{-6}$, half of the muons are transferred to neon. Transfer to neon is 3 times more frequent if the hydrogen contains enough deuterium to saturate the reaction $(\mu^-p) + d \rightarrow (\mu^-d) + p$. Transfer to helium is at least two orders of magnitude slower than to neon. Stars induced by μ^- and π^- were analyzed. No transfer of π^- was detected. The effect of the transfer reactions on the measurement of μ^- capture by hydrogen is discussed. It is shown that the transfer reactions can be used for experiments on μ^- capture by separated neon isotopes and possibly by He^3. (auth)

5883 ANALYTICITY AND CROSSING FOR PARTIAL WAVES. J. G. Taylor (Rias, Baltimore). Nuovo cimento (10), 22: 92-101(Oct. 1, 1961). (In English)

It is proved that the use of crossing symmetry, analyticity, and unitarity to determine partial wave amplitudes is valid for every order in perturbation theory. This is shown for the equal mass case. An approximation scheme is developed for evaluating the left-hand cut contribution to a partial wave dispersion relation, which should be more reliable than a Legendre polynomial expansion. (auth)

5884 ON THE EXISTENCE OF SOLUTIONS OF THE PION-PION DISPERSION EQUATIONS. [PART] II. C. Lovelace (Imperial Coll. of Science and Tech., London). Nuovo cimento (10), 22: 102-15(Oct. 1, 1961). (In English)

The Shirkov equations are shown to be consistent without a cut-off, unlike the Chew-Mandelstam equations. Their asymptotic behavior at high energies can be determined exactly. This can be used to make predictions about the signs of the various partial waves, and in some cases about the existence of resonances. The behavior at infinity is always of Gribov type, even with a P-wave resonance. (auth)

5885 DIFFERENTIAL CROSS-SECTION FOR THE D(d,n) REACTION. C. Milone and R. Ricamo (Università, Catania, Italy; Centro Siciliano di Fisica Nucleare, Catania, Italy; and Istituto Nazionale di Fisica Nucleare, Sezione Siciliana, Italy). Nuovo cimento (10), 22: 116-22 (Oct. 1, 1961). (In English)

The differential cross section for the D(d,n) reaction was measured at $E_d = 1.6$ and 0.6 Mev. Neutrons emitted at different angles where detected by recoil protons in nuclear emulsions. In the laboratory system the ratio $\sigma(0°)/\sigma(90°)$

is 8.2 ± 0.8 at E_d = 1.6 Mev and 4.2 ± 0.4 at E_d = 0.6 Mev, according to the average known values. (auth)

5886 SINGLE PION PRODUCTION IN PROTON-PROTON COLLISIONS ACCORDING TO THE ONE-PARTICLE EXCHANGE MODEL. G. Da Prato (C.N.E.N., Frascati, Italy). Nuovo cimento (10), 22: 123-34(Oct. 1, 1961). (In English)

Single-pion production in nucleon-nucleon collisions is calculated in the one-pion exchange approximation. All possible diagrams of this kind are calculated in the "pole" approximation discussed; interferences between them are taken into account. The laboratory energy spectra of the final nucleons are calculated and compared with the experimental data at 2.85 Bev. This comparison shows a remarkably good agreement for small values of the squared 4-momentum of the virtual pion. For higher values the qualitative behavior is still reproduced, but the theoretical absolute values are larger than the experimental ones. (auth)

5887 INTERFERENCE EFFECTS OF RADIOFREQUENCY FIELDS IN RESONANCE RADIATION. M. N. Hack (Argonne National Lab., Ill.). Nuovo cimento (10), 22: 168-77(Oct. 1, 1961). (In English)

The theory developed previously to investigate the splitting of Zeeman lines by r-f magnetic fields leads directly to the Brossel-Bitter resonance obtained in experiments on double resonance. An extension of the theory accounts for the effects of the modulation of light recently observed in these experiments. (auth)

5888 ANALYTIC PROPERTIES OF n-POINT LOOPS IN PERTURBATION THEORY. L. M. Brown (Northwestern Univ., Evanston, Ill.). Nuovo cimento (10), 22: 178-82 (Oct. 1, 1961). (In English)

It is shown that simple perturbation graphs consisting of closed n-vertex loops have only the singularities possessed by reduced loops, obtained by "fusing" two or more of the vertices and omitting the internal lines which join them. The theorem holds providing $n \geq 6$. (auth)

5889 HIGH-ENERGY NUCLEON-NUCLEON COLLISIONS. W. K. R. Watson (California Inst. of Tech., Pasadena). Nuovo cimento (10), 22: 183-8(Oct. 1, 1961). (In English)

It is shown that single-vector meson exchange processes which may give rise to the repulsive core in nucleon-nucleon collisions, yield an elastic scattering cross section which approaches a constant value in the limit of infinitely large energy. Limits on the values of mass and coupling constant of this meson are inferred from high energy data, in particular a value for the strength of the ρ nucleon interaction is determined from the charge-exchange section data. (auth)

5890 ELIMINATION OF THE INELASTIC CUT IN THE N/D METHOD. M. Froissart (Univ. of California, Berkeley). Nuovo cimento (10), 22: 191-2(Oct. 1, 1961). (In English)

A method for treating contributions from the inelastic region, for problems to be solved by the N/D method, is proposed in order to reduce it to a problem without inelastic parts. The method does not lead to an equation involving principal-value integrals, and the final equations obtained are, in general, singular. (L.N.N.)

5891 π^--PROTON SCATTERING AT 516, 616, 710, 887, AND 1085 MeV. F. Grard (CERN, Geneva), G. Macleod, L. Montanet, M. Cresti, R. Barloutaud, C. Choquet, J.-M. Gaillard, J. Heughebaert, A. Leveque, P. Lehmann, J. Meyer, and D. Revel. Nuovo cimento (10), 22: 193-8 (Oct. 1, 1961). (In English)

Results on π^--p scattering at kinetic energies of 516, 616, 710, 887, and 1085 Mev are presented in graphical and tabular form. Data were obtained by exposing a liquid-hydrogen bubble chamber to a pion beam from the Saclay proton synchrotron. The chamber had a diameter of 20 cm and a depth of 10 cm. There was no magnetic field. At the highest energies under consideration, a peak appears in the forward direction. If this is interpreted as due only to shadow scattering, reasonable agreement with the angular distribution at 1085 Mev is obtained by taking for the optical radius a value of 1.08×10^{-13} cm, consistent with results at 1.2 to 1.3 Bev. (L.N.N.)

5892 QUENCHING OF MUON DEPOLARIZATION BY WEAK MAGNETIC FIELDS. G. Charpak, F. J. M. Farley, R. L. Garwin, T. Muller, J. C. Sens, V. L. Telegdi, C. M. York, and Z. Zichichi (CERN, Geneva). Nuovo cimento (10), 22: 199-202(Oct. 1, 1961). (In English)

If muons are stopped in an electrically conducting material they suffer very little depolarization. In insulators the results are variable, some materials giving no depolarization (bromoform, methylene iodide), while in others (sulfur, NaCl) the depolarization is almost complete. Depolarization in the case of a plastic scintillator target was measured. Re-establishment of polarization at low fields was detected. At ~150 gauss, the asymmetry reached about 50% of its full value. Results are represented in graphical form. (L.N.N.)

5893 RELATIONS BETWEEN POLARIZATIONS DUE TO CHARGE INDEPENDENCE. L. Michel (Laboratoire de Physique Théorique et Hautes Energies, Orsay, France). Nuovo cimento (10), 22: 203-7(Oct. 1, 1961). (In English)

The relation that exists between the polarizations of corresponding particles in reactions identical from the point of view of charge independence is studied. The simplest non-trivial case and most useful for practical applications is considered. Mathematical derivations are presented. (L.N.N.)

5894 KAON-NUCLEON DISPERSION RELATION AND THE HYPERON EXCITED STATES. K. Igi and H. Shimoida (Tokyo Univ. of Education). Nuovo cimento (10), 22: 208-13 (Oct. 1, 1961). (In English)

Recent experimental evidence suggests the possible existence of the I = 0 excited state, Y_0^*, which strongly decays into $\pi + \Sigma$, in addition to the I = 1 excited state. The half widths are less than 20 Mev. Analysis to determine the type of K coupling by making use of dispersion relations is re-examined. It is noted that the ($\alpha-$) solution predicts the binding energy for Y_1^* to be ~47 Mev and the half width $\Gamma/2 \sim 15$ Mev on the basis of the zero range theory, values which are consistent with experimental data. This solution also suggests, however, the binding energy for the Y_1^* to be ~0.5 Mev and a wider width 27 Mev which do not appear to be consistent with present data. Consistency of the ($\alpha-$) solution is checked by making use of an appropriate form of the dispersion relation. The ($\alpha-$) solution, which predicts the S state both for Y_1^* and Y_0^*, is found to be probably though not definitely inadequate. This suggests that at least one of the two resonant states may be the P state. (L.N.N.)

5895 POLOLOGY AND N D^{-1} SOLUTIONS IN THE MULTIPLE-CHANNEL PROBLEMS. G. Costa (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua) and F. Ferrari. Nuovo cimento (10), 22: 214-17 (Oct. 1, 1961). (In English)

The ND^{-1} technique is successfully extended to the multiple-channel problems, providing also a means for constructing partial wave amplitudes satisfying the requirements of unitarity and analyticity. However, the complexity deriving from the matrix nature of the amplitude $G = ND^{-1}$ greatly limits the possibility of practical application to cases in which the unphysical singularities are approximated by a certain number of poles. Simplifications of the methods involved in the ND^{-1} technique are presented, and the problem of G-matrix symmetry is examined by giving a direct proof for the case of an arbitrary number of poles. The actual expressions of the matrices N and D are used explicitly. Formulas useful for practical calculations may be derived from the material presented. (L.N.N.)

5896 π-Y RESONANCES AND K^- ABSORPTION REACTIONS. J. S. Dowker (Univ. of Birmingham, Eng.). Nuovo cimento (10), 22: 218-21(Oct. 1, 1961). (In English)

The capture reactions $K^- + He^4 \rightarrow \Lambda + \pi^- + He^3$ and $K^- + He^4 \rightarrow \Sigma^\pm + \pi^\pm + H^3$ are discussed, with π-Y resonances in mind. An isospin 1 resonance, the Y_1^*, and isospin 0 resonance, the Y_0^*, are invoked in the π-Y system. The He^3 recoil spectrum with $M_1 \approx 1380$ Mev, $\Delta^0 \approx 15$ Mev and the H^3 recoil spectrum with $M_0 \approx 1410$ Mev, $\Delta_0 \approx 15$ Mev are calculated. The Gaussian and Butler vertices are noted. There seems to be evidence for a π-Σ isospin 0 resonance with mass around 1400 Mev and width ~15 Mev. The analysis shows the importance of the $He^4 \rightarrow I^3 + N$ vertex, the variation of which introduces structure into the spectator spectrum. (L.N.N.)

5897 ANNIHILATION OF POLARIZED POSITRONS IN MAGNETIZED IRON. W. D. McGlinn (Northwestern Univ., Evanston, Ill.). Nuovo cimento (10), 22: 225-34(Oct. 16, 1961). (In English)

An attempt is made to describe the integral angular correlations for annihilation of polarized positrons in iron, for a saturating magnetic field. A comparison with experiment is made. The positron wave function used to calculate the angular correlation for annihilation of the 3s, 3p, and 3d electrons of iron is that obtained by a Wigner-Seitz calculation for zero crystal momentum, the potential in the Schrödinger equation being taken as the ion core potential. The inner electron wave functions are assumed to be those of free atomic iron. The angular correlation for the conduction electron annihilation is calculated assuming a degenerate Fermi gas for the electrons and a zero-momentum wave function for the positron. (auth)

5898 INVESTIGATION OF AZIMUTHAL EFFECTS AT MULTIPLE PARTICLE PRODUCTION. S. A. Azimov, L. P. Chernova, G. M. Chernov, V. M. Chudakov, and B. K. Nikishin (Physical-Technical Inst., Academy of Sciences of the Uzbek SSR, Tashkent). Nuovo cimento (10), 22: 235-50 (Oct. 16, 1961). (In English)

The azimuthal angular distribution of the secondary particles produced in p-nucleus collisions at 9 Bev and in nuclear interactions of single-charged cosmic ray particles in photoemulsion are investigated. The influence of the energy-momentum conservation law is estimated. The experimental results are compared with theories and models of nuclear interactions produced by high energy nucleons. (auth)

5899 POSITRON ANNIHILATION IN INSULATORS. A. Bisi, A. Fasana, E. Gatti, and L. Zappa (Istituto di Fisica del Politecnico, Milan). Nuovo cimento (10), 22: 226-74(Oct. 16, 1961). (In English)

The time distribution of the positron annihilation radiation in various plastic insulators is measured with a time-to-height converter. For each material, the abundance I_2 and the mean life τ_2 of long lived positronium were measured, together with the mean life τ_1 of positrons annihilating with shorter lifetime. The obtained values for I_2, τ_2, and τ_1 were found to vary respectively between 10 and 45%, 1.2 and 2.6 mμsec, and 1.5×10^{-10} and 3.0×10^{-10} sec. The bulk of the τ_1 component being made up of the non-positronium decay, the τ_1 values yielded the mean life τ_f for the unbound positron annihilation. τ_f was found to vary between 1.5×10^{-10} and 3.0×10^{-10} sec. A rough attempt to correlate the measured lifetimes with the effective electron densities suggested that polarization effects connected with microscopic fields played a significant role. (auth)

5900 ON THE EMISSION OF NEUTRON HYPERONS FROM K^--INTERACTIONS AT REST WITH EMULSION NUCLEI. D. H. Davis (University Coll., London), M. Csejthey-Barth, J. Sacton, B. D. Jones, B. Sanjeevaiah, and J. Zakrzewski. Nuovo cimento (10), 22: 275-84 (Oct. 16, 1961). (In English)

A systematic search is made for decays of Λ^0 hyperons near 5,262 interactions of K^- mesons at rest in photographic emulsion. From the 41 observed decays of correlated Λ^0 hyperons, it is estimated that (47 ± 7)% of all K^- meson interactions at rest in emulsion nuclei emit neutral hyperons. On consideration of the conservation of strangeness it is suggested that cryptofragments are formed in (30 ± 7)% of all such K^- meson absorptions and that the non-mesonic decays of these cryptofragments give rise to a considerable proportion of the protons of energies greater than 60 Mev emitted from K^- meson captures. (auth)

5901 THE MASS OF THE Λ^0-HYPERON. B. Bhowmik, D. P. Goyal, and N. K. Yamdagni (Univ. of Delhi). Nuovo cimento (10), 22: 296-303(Oct. 16, 1961). (In English)

An accurate determination of the Λ^0 mass is made in nuclear emulsion. From an analysis of 101 Λ^0 decays; the mass of the Λ^0 hyperon is found to be (1115.46 ± 0.15) Mev and $Q_\Lambda = (37.62 \pm 0.14)$ Mev. (auth)

5902 EXTRAORDINARY HIGH-ENERGY NUCLEAR INTERACTIONS OF μ-MESONS. S. Higashi, T. Kitamura, Y. Mishima, S. Miyamoto, T. Oshio, H. Shibata, and Y. Watase (Osaka City Univ.). Nuovo cimento (10), 22: 304-7(Oct. 16, 1961). (In English)

An observation on penetrating showers produced by high-energy μ-mesons was done at 50 m.w.e. underground by the use of two large multiplate cloud chambers. In the course of the analysis, one large nuclear shower was found whose energy transferred from μ mesons seemed to be larger than 300 Bev. The rate of this type of event would be very large compared with the conventionally expected one. (auth)

5903 MULTIPLE SCATTERING MEASUREMENTS IN NUCLEAR EMULSIONS EXPOSED TO MOMENTUM-ANALYSED PARTICLE BEAMS FROM THE CERN PROTON SYNCHROTRON. A. Hossain, M. F. Votruba, and A. Wataghin (CERN, Geneva). Nuovo cimento (10), 22: 308-17 (Oct. 16, 1961). (In English)

Results of multiple Coulomb scattering measurements on the tracks of high momentum particles in nuclear emulsion are described. It is shown that the method can be used to give reliable momentum estimates, for particles whose tracks are essentially flat in the emulsion, up to 25 Bev/c. Possible deviations from theoretical multiple Coulomb scattering expectations for high cell-sizes are presented. (auth)

5904 MAGNETIC DEFLECTION OF POSITIVE IONS IN LIQUID HELIUM AT 0.2°K. G. Careri, F. Duprè, and I. Modena (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10), 22: 318-25 (Oct. 16, 1961). (In English)

The mobility of positive ions in liquid helium at about

0.2°K is measured by the magnetic deflection of an ionic beam. The mobilities are well below the extrapolated values predicted from the higher temperature behavior. (auth)

5905 THE ISOSCALAR AMPLITUDES FOR MESON PHOTOPRODUCTION. A. E. A. Warburton and M. Gourdin (Laboratoire de Physique Théorique et Hautes Energies, Orsay, France). Nuovo cimento (10), 22: 362-73(Oct. 16, 1961). (In English)

An investigation is made into the form of the isoscalar amplitudes for meson photoproduction on nucleons, using the Mandelstam technique, for energies up to 250 Mev. The "bipion" approximation to the pion-pion interaction is used, and, in the photoproduction channel, an intermediate $I = \frac{1}{2} = J$ pion-nucleon state is considered. The results agree with the experimental values of $d\sigma^-/d\sigma^+$, giving strong evidence for the existence of the pion-pion resonance. An estimate of the "coupling constant" for the process $\gamma + \pi \rightarrow \pi + \pi$ is hence obtained. (auth)

5906 THE EFFECT OF A PION-PION INTERACTION ON THE π^0 PHOTOPRODUCTION. B. De Tollis (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo cimento (10), 22: 406-13(Oct. 16, 1961). (In English)

It is shown that the results of a dispersive theory, taking into account the π-π interaction in the $T = J = 1$ 2π resonance state and in the $T = 0$, $J = 1$ 3π state (with a suitable choice of parameters), are in agreement with experimental data on π^0 photoproduction on protons for energies from threshold to 400 or 450 Mev. (auth)

5907 COMPOSITE PIONS. P. E. Kaus (Univ. of Southern California, Los Angeles) and W. K. R. Watson. Nuovo cimento (10), 22: 432-4(Oct. 16, 1961). (In English)

The assumptions that the vector mesons are elementary, and that the pseudoscalar mesons (π, etc.) are dynamic resonances, are shown to lead to the existence of an isotopic singlet π_4 meson that is lighter than the normal π meson. Since experience shows that the existence of the π_4 is improbable, it is concluded that the π mesons, and not the vector mesons, are elementary. (T.F.H.)

5908 SOME REMARKS ABOUT LOW-ENERGY PION-PION SCATTERING. C. Ceolin (Università, Padua) and R. Stroffolini. Nuovo cimento (10), 22: 437-40(Oct. 16, 1961). (In English)

The anomalous He^3 spectrum from p-d interactions may be interpreted in terms of a $T = 0$ π-π resonance near threshold, with a scattering length a_0 of 2.5 ± 0.4 pion Compton wavelengths. Considering the reaction $\pi^- + p \rightarrow \pi^+ + \pi^- + n$, it is shown that the $T = 2$ π-π resonance interferes strongly with the $T = 0$ resonance. The combined scattering lengths a_0 and a_2 may be used to calculate the cross sections for the reaction. Comparison of these calculations with experiment show that a_0 is limited to values below 1 pion Compton wavelength. Thus doubt is cast on the a_0 value found from the p-d interaction data. (T.F.H.)

5909 π^+-PROTON SCATTERING AT 990 Mev. J. K. Kopp (Brookhaven National Lab., Upton, N. Y.), A. M. Shapiro, and A. R. Erwin. Phys. Rev., 123: 301-7(July 1, 1961).

Positive-pion scattering at 990 ± 30 Mev was examined in a 6 × 3 × 2 in. hydrogen bubble chamber without a magnetic field. The cross sections for elastic and inelastic scattering were found to be 15.3 ± 1.5 mb and 12.6 ± 3.3 mb, respectively. The inelastic scattering cross section includes $0.19^{+0.09}_{-0.07}$ mb of Σ^+-K^+ production and 0.78 ± 0.14 mb of $\pi^+\pi^+\pi^-p$ production. A simple pion-pion model which predicts the branching ratios for double pion production in π^--p collisions is found to be inconsistent with the double pion production observed in this experiment. The relation of the experiment to π^--p experiments in the region of the second and third resonances is discussed. (auth)

5910 SOME COMMENTS ON THE REACTION MATRIX FOR A MANY-BOSON SYSTEM. W. E. Parry (Clarendon Lab., Oxford). Physica, 27: 1045-53(Nov. 1961). (In English)

Doubts are expressed on the usefulness of the conventional reaction matrix for many-boson systems whose densities are not low. It is suggested that the modified reaction matrix of Nozières and Pines approaches zero for low momenta so that the low-momentum linear portion of the excitation spectrum is lost, and the condition for the existence of superfluidity is no longer obeyed. A way out of this difficulty is suggested, but it is pointed out that there is no good reason for thinking that the reaction matrix is a useful quantity for high density systems. (auth)

5911 THE RADIATIVE CAPTURE OF PROTONS BY NEUTRONS AT 50 MEV. N. C. Barford, R. B. Palmer, and B. Tallini (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 78: 912-17(Nov. 15, 1961).

By using an internal lithium deuteride target in the Harwell cyclotron, and hardening the resulting scattered neutrons with polythene, a low intensity beam of neutrons with an energy peak at 50 Mev was produced. This beam passed through a 9 cm hydrogen bubble chamber and produced the reactions of the type $n + p \rightarrow d + \gamma$ which were distinguished by the range-angle distribution of the deuterons from the background of elastic n-p scatters. A cross section of 110 ± 60 μb was found for the process. (auth)

5912 MEASUREMENTS OF QUENCHING OF ORTHO-POSITRONIUM IN GASES. F. F. Heymann (University Coll., London), P. E. Osmon, J. J. Veit, and W. F. Williams. Proc. Phys. Soc. (London), 78: 1038-47(Nov. 15, 1961).

Three photon annihilations of ortho-positronium in gases as a function of pressure were investigated using a scintillation spectrometer technique. Quenching rates per atmosphere were determined for argon ($0.035\lambda_0$), neon ($0.024\lambda_0$), helium ($0.014\lambda_0$), oxygen ($3\lambda_0$), nitric oxide ($400\lambda_0$), and carbon dioxide ($0.08\lambda_0$), the last three being only very approximate. λ_0 is the natural annihilation rate of ortho-positronium, 0.7×10^7 sec^{-1}. The high quenching rates in oxygen and nitric oxide are attributed to ortho-to-para conversion by electron exchange. The order of magnitude of the smaller quenching rates is understandable if the positronium atom annihilates with an electron of a gas molecule during collision (pick-off quenching). (auth)

5913 QUALITATIVE ANALYSIS OF DISPERSION EQUATIONS OF SOME CYLINDRICAL PERIODIC STRUCTURES. V. P. Shestopalov and O. A. Tret'yakov (Khar'kov State Univ.). Zhur. Tekh. Fiz., 31: 1379-87(Nov. 1961). (In Russian)

Propagation of slow electromagnetic waves in cylindrical systems (spiral, double spiral with a reverse winding, modified double spiral with a reverse winding, etc.), described by dispersion equations, is analyzed by a variational method. (R.V.J.)

5914 VVEDENIE V THORIYU MNOGOKRATNOGO RASSEYANIYA CHASTITS. (Theory of Multiple Scattering of Particles). N. F. Nelipa. Moscow, Atomizdat, 1960. 159p.

Gamma, neutron and electron multiple scattering during passage through substances are discussed, and methods for setting up the scattering problem, the calculations, and results are given in an expanded and revised course of lectures given by the author at the Moscow Inst. of Engineering Physics. (R.V.J.)

5915 THE RELATION BETWEEN THE PHOTOPRODUCTION AND THE SCATTERING OF π-MESONS. N. F. Nelipa. Translated by Prasenjit Basu. International Series of Monographs on Nuclear Energy. Division II: Nuclear Physics. Volume 5. New York, Pergamon Press, 1961. 106p. $5.00.

A multipole analysis of the transition amplitude for photoproduction of pions on nucleons is presented, using known data on pion-nucleon scattering phase shifts in order to determine some of the photoproduction matrix elements. Photon energies up to the $^3/_2$-$^3/_2$ resonance ($\leq$400 Mev) are considered. Combination of this derived data and the experimental photoproduction data allow the determination of an expression for the photoproduction differential cross section. Attention is also given to the polarization of the outgoing nucleons. (T.F.H.)

Neutron Physics

5916 (AFSWC-TR-61-85) THE TRANSPORT OF NEUTRONS THROUGH THE ATMOSPHERE FOR A BURST HEIGHT OF 70,000 FEET. Alexander E. Anthony, Jr. (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Oct. 1961. 62p.

A series of curves is presented depicting the neutron flux per initial neutron from a burst height of 70,000 feet and sampling altitudes from 50,000 to 100,000 feet. The scattered flux data for these curves were calculated from a Monte Carlo code. The direct flux data were calculated by the standard inverse square method. (auth)

5917 (BRL-Memo-1374) USE OF THE DISCRETE ORDINATE METHOD FOR DESCRIBING THE TRANSPORT OF FAST NEUTRONS THROUGH IRON SLABS. R. H. Peterson and H. W. Ege (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Oct. 1961. 39p.

The use of the discrete ordinate method for solving a simplified form of the neutron transport equation as a semi-empirical description of dose transmission through iron slabs was investigated. The basic information to which the model was fitted consists of a detailed set of Monte Carlo results which takes into account the incident energy and direction, the slab thickness, and the exit direction. For 0.16-Mev neutrons, the fit was found to be excellent in all respects. At energies of 0.85, 1.2, 2.0, and 4.0 Mev, the total dose transmission was found also to give a good fit but its angular density and the total dose reflection were somewhat in error. (auth)

5918 (WAPD-T-1384) SELF-SHIELDED BORON REPRESENTATION FOR PWR-2. N. G. Demas and R. C. Shank (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1961. Contract AT(11-1)-Gen-14. 25p.

Presented at ANS Meeting, Chicago, Nov. 1961.

A procedure has been devised to describe explicit self-shielded poison regions in neutron diffusion theory calculations in two dimensions. The method is illustrated for a particular poison and fuel geometry, and the effective constants obtained are used in several test geometries. The relative capture rate of the poison to fuel, $\int_{\text{poison}} \Sigma_a \phi \, dv/\int_{\text{fuel}} \Sigma_a \phi \, dv$, in these examples, as calculated from one-group diffusion theory problems using these effective thermal constants, is obtained as a function of the physical absorption cross section in the poison. The capture ratios are compared with the relative capture rates obtained from explicit Monte Carlo calculations, and from diffusion theory calculations which use one-dimensional blackness theory to represent the poison. An approximate analytic expression is obtained for the effective thermal constants as a function of the poison parameters. This expression has been used to determine effective constants with which to describe poison regions in reactor calculations which may be compared with experiments. (auth)

5919 ISOPERIMETRIC AND OTHER INEQUALITIES IN THE THEORY OF NEUTRON TRANSPORT. Lawrence Dresner (Kernforschungszentrum, Karlsruhe, Ger.). J. Math. Phys., 2: 829-47(Nov.-Dec. 1961).

Isoperimetric and other inequalities occurring in the one-velocity theory of neutron transport are derived. The quantities involved in these inequalities all refer to bare solids with isotropic scattering and are: the critical multiplication, the first-collision probability, the non-escape probability, and the buckling. The inequalities proved provide upper and lower bounds for the quantities considered, and examples of the estimation of these quantities in cases not readily amenable to direct calculation are given. (auth)

5920 POLARIZATION OF NEUTRONS FROM THE REACTION D(d,n) He^3 AT A DEUTERON ENERGY OF 5.5 Mev. Paul Avignon, Yvon Deschamps, and Louis Rosier. J. phys. radium, 22: 563-5(Oct. 1961). (In French)

The maximum polarization of the neutrons of the reaction D(d,n)He^3 for a neutron energy of 5.5 Mev was investigated. The polarization is measured from the right-left asymmetry observed in the scattering on He^4. (auth)

Nuclear Properties and Reactions

5921 (HEPL-246) PHOTOPROTONS FROM OXYGEN, FLUORINE, NEON, AND OTHER LIGHT ELEMENTS (thesis). William R. Dodge (Stanford Univ., Calif. High-Energy Physics Lab.). Oct. 1961. Contract N6onr-25116. 146p.

The (γ,p) reaction in O, F, Ne, and C has been studied with electrons of energies up to 36 Mev. Survey studies were made of the Al, Ar, and B (γ,p) energy spectra. The reactions were initiated by electrons, and not real photons; but it has been theoretically predicted and received partial experimental verification that there is a one-to-one correspondence between electron- and photon-induced reactions, and that one can assume, when analyzing electron-production yields, that the electron has associated with it a virtual-photon spectrum, sinilar to the real-photon Bremsstrahlung spectrum. The virtual and Bremsstrahlung spectra differ, however, in that the virtual-photon spectrum depends on the multipolarity of the induced transition and the angle between the incident electron beam and the emitted disintegration product, while the Bremsstrahlung spectrum does not. The electron production yields were analyzed with the use of the E-1 virtual-photon spectrum to obtain $\sigma(\gamma,p)$. The proton yields and corresponding cross sections of O, F, and Ne contain more than two peaks or resonances. Neon exhibits the most interesting spectrum. It has a series of well-resolved, evenly-spaced peaks whose envelope has the usual giant-resonance shape. The peaks occur at laboratory proton energies of 3.20, 3.70, 4.58, 5.80, 6.65, 7.75, 8.65, 9.40, and 11.40 Mev. The final-state properties of the Ne protons from 4 to 10 Mev and the O protons from 9.2 to 12.4 Mev were determined to within 20% by excitation experiments. Angular distribution measurements over a considerable region of the giant resonances are presented for O, F, Ne, and C. The following integrated cross-section estimates and limits were obtained: $O^{16} \int_{16.6}^{27} \sigma(\gamma,p)dE_\gamma = 56 \pm 11$ Mev-mb; $F^{19} \int_{10.5}^{23} \sigma(\gamma,p)dE_\gamma = 29^{+8}_{-3}$ Mev-mb; Ne $\int_{16}^{27} \sigma(\gamma,p)dE_\gamma = 65^{+13}_{-10}$ Mev-mb; $C^{12} \int_{20.3}^{29.3} \sigma(\gamma,p)dE_\gamma = 50 \pm 8$ Mev-mb; $Al^{27} \int_{18.5}^{29} \sigma(\gamma,p)dE_\gamma = 94 \pm 19$ Mev-mb; 62 Mev-mb $\leqq A^{40} \int \sigma(\gamma,p)dE_\gamma \leqq 100$ Mev-mb; and 25 Mev-mb $\leqq B \int_{13.8}^{27} \sigma(\gamma,p)dE_\gamma \leqq 42$ Mev-mb. (auth)

5922 (JINR-D-788) THE TOTAL CROSS SECTION FOR INTERACTION OF NEUTRONS WITH PROTONS AT THE ENERGY OF 8.3 BeV. L. Ozhdyani (Ozhdanji), V. S. Pantuev, M. N. Khachaturyan, and I. V. Chuvilo (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 5p.

The total cross section for neutron-proton interactions was measured at a neutron energy of 8.3 ± 1.3 Bev under good geometry conditions. It was found to be 41.2 ± 2.6 mb. (auth)

5923 (JINR-P-764) POLNYE SECHENIYA REAKTSII T + T V INTERVALE ENERGII 60-1140 KEV. (Total Cross Sections of the T + T Reaction in the Energy Range 60-1140 Kev). A. M. Govorov, Ka-en Li, G. M. Osetinskii, V. I. Salatskii, and I. V. Sizov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1961. 26p.

The total cross sections for the reaction t + t were determined in the triton energy range of 60 to 1140 kev. The measurements were conducted with a thin gaseous target. The total cross section increases monotonously from 10 mb at 60 kev up to 82 mb at 1140 kev. A comparison of the total cross sections for the reactions t + t and $He^3 + He^3$ indicates that the contribution of direct interaction processes is essential. (auth)

5924 (JINR-P-777) TABLITSY FAZOVYKH OB'EMOV. (Tables of Phase Volumes). G. I. Kopylov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 35p.

Tables are given for the calculation of statistical weights of main multiple production reactions over all the energy range of particle interaction under the assumption that covariant statistical theory of multiple production is valid. The tables contain values of log Ψ_n for Z_n in the interval (0.1), which is to be used in equations to calculate the phase volume of n particles, statistical weights, and momentum and angular distributions. (D.L.C.)

5925 (JINR-P-786) ASIMMETRIYA I SIMMETRIYA MASS OSKOLKOV PRI DELENII YADER. (OBZOR). (Asymmetry and Symmetry of Mass Fragments in Nuclear Fission (Review)). N. I. Tarantin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1961. 26p.

The asymmetry and symmetry of nuclear fission fragment mass and problems of transmission of nuclear substance according to their mass are analyzed using nuclei with Z < 90. Fission events at low and medium-low excitation energies were reviewed. Experiments indicated that the fission of light (pre-thorium) nuclei differs considerably from fission in thorium and heavier nuclei. The fission made was not alike for all the examined light nuclei. (R.V.J.)

5926 (JINR-P-801) PRANYE KORRELYATSII SVERKHPROVODYASHCHEGO TIPA V ATOMNYKH YADRAKH. (Superconducting Type of Pair Correlations in Atomic Nuclei (thesis)). V. G. Solov'ev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 85p.

The theory of superconductivity is used in studies of ground and low-excitation levels. Comparisons of superconducting nucleon pairing correlations with experimental data show that residual reactions are gravitational in character and ground and low-level excitations are in a superfluid state. The superfluid nuclear model was formulated and its properties are analyzed. Correlations of the experimental data with calculations based on the superfluidity model show that the model correctly reflects the properties of ground and low-excitation states in strongly deformed nuclei and should prove useful in further studies of nuclear properties. (R.V.J.)

5927 (JINR-P-802) γ-SPEKTRY V REAKTSIYAKH S TYAZHELYMI IONAMI. (Gamma Spectra in Heavy Ion Reactions). Yu. Ts. Oganesyan, Yu. V. Lobanov, B. N. Markov, and G. N. Flerov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1961. 16p.

A single-crystal spectrometer was used in an investigation of the γ spectra of Cu, Ta, W, and U targets exposed to O^{16} ions at 80 to 140 Mev. The cascade emission of 20 to 30 soft γ quanta was observed in each compound nucleus formation. The effect of the angular momentum on the mechanism of excited nucleus decay is discussed. (auth)

5928 (JINR-P-805) POLNYE SECHENIYA VZAIMODEISTVIYA P^--MEZONOV S PROTONAMI PRI VYSOKIKH ENERGIYAKH. (Total Cross Sections of π^--Meson Interactions at High Energies). A. S. Vovenko, L. B. Golovanov, B. A. Kulakov, A. L. Lyubimov, Yu. A. Matulenko, I. A. Savin, and E. V. Smirnov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 11p.

The total cross sections for meson(π^-) interactions with protons were measured for the momenta 3.4, 3.9, 4.9, 7.0, and 9.2 Bev/c. The results of the measurements indicated a slow decrease of the cross sections with energy. (auth)

5929 (JINR-P-806) ON STRANGE PARTICLE PRODUCTION IN π^- p INTERACTION. V. I. Veksler, I. Vrana, E. (Ye.) N. Kladnitskaya, A. A. Kuznetsov, A. K. Mihul, E. K. Mihul, Dinh Tu Nguyen, V. N. Penev, M. I. Solovev (Soloviev), T. Hofmokl, and Ling-yen Chen (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 9p.

Data are presented which were obtained in studies of $\pi^- + p$ interactions accompanied by production of strange particles in a propane bubble changer with a π^- beam of momentum 7 and 8 Bev/c. The reaction $\pi^- + p \rightarrow \Lambda + K + n\pi$, $\Lambda \rightarrow \pi + p$ was used for baryon identification, and 428 events were analyzed for Λ^0 momentum and angular distributions and for changes in baryon momentum. The results are in good agreement with the vector variant of a K' meson. (D.L.C.)

5930 (LA-2643) THE NEUTRON-INDUCED DISINTEGRATION OF Li^6 AND Li^7 BY 5- TO 14-MEV INCIDENT NEUTRONS. Louis Rosen and Leona Stewart (Los Alamos Scientific Lab., N. Mex.). Jan. 1956. Contract W-7405-eng-36. 117p.

A detailed study of the $Li^6(n,dn)He^4$ and $Li^7(n,tn)He^4$ reactions was made at 5 to 14 Mev. The reaction cross sections, as well as the spatial and spectral distributions of all reaction products, were determined for eleven energies for Li^7 and twelve energies for Li^6. The high reaction cross sections have important implications for the design of mobile reactor shields. (auth)

5931 (ORNL-3205) NUMERICAL ANALYSIS OF NEUTRON RESONANCES. Susie E. Atta and John A. Harvey (Oak Ridge National Lab., Tenn.). Jan. 10, 1962. Contract W-7405-eng-26. 62p.

Neutron resonances are analyzed numerically by determining the resonant energies, the total widths, and the neutron widths of the resonances. It was assumed that the total cross section can be represented by the sum of single-level Breit-Wigner formulas, with interference between resonance and potential scattering but no interference between resonances; that the Doppler broadening is represented by a Gaussian function; and that the instrument resolution is represented by a Gaussian function. Gauss' method was used to reduce the nonlinear problem to one in which linear methods can be applied. Some unusual techniques were used for evaluating the integrals in the function for calculating the transmission. Two programs for analyzing transmission data to obtain the parameters of the resonances were written for the IBM 7090 computer. The first program is a shape analysis for determining the resonant energies, the total widths, and the neutron widths of the resonances. This program analyzes the transmission data for as many as six resonances at once. The second program is an area analysis for determining the neutron widths of the resonances for assumed total widths. This program analyzes transmission data containing as many as 20 resonances at once. (auth)

5932 (WAPD-T-1385) A GENERALIZED TREATMENT OF FISSION FRAGMENT POISONING. T. R. England and R. J. Eckert (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1961. Contract AT(11-1)-Gen-14. 17p.

Presented at ANS Meeting, Chicago, Nov. 1961.

An analytical method is outlined by which the detailed time dependence of the fission fragment poison can be calculated. Both β^- decay and reactor power history are explicitly included. Several fissioning nuclides may simultaneously provide a source to the fragment concentrations. A specific 18-chain representation of the fission fragments is given, and some representative calculations based on these chains for U-235 are presented. (auth)

5933 ON THE SEPARATION METHOD FOR CALCULATING THE NUCLEAR REACTION MATRIX. H. S. Koehler (Univ. of California, Los Angeles). Ann. Phys. (N. Y.), 16: 375-86(Dec. 1961).

The separation method for calculating the nuclear reaction matrix that was presented by S. A. Moszkowski and B. L. Scott (Annals of Physics 11, 65(1960)) was investigated. Estimates are made which suggest that their dispersion, interference, and Pauli corrections are underestimated. A modification in the treatment of these terms is presented that gives considerable improvement. The treatment also permits insight into the nature of the approximations. Errors in the new method are discussed. An alternative approximation that involves an iteration of the dispersion correction is also suggested. (auth)

5934 A STUDY OF THE ANGULAR CORRELATION OF ANNIHILATION GAMMA-QUANTA IN ZINC. I. Ya. Dekhtyar and V. S. Mikhalenkov. Doklady Akad. Nauk S.S.S.R., 140: 1293-6(Oct. 21, 1961). (In Russian)

The angular distributions of annihilation γ-quanta were determined at 90°K and 300°K for a zinc single crystal (99.98% purity) in a plane parallel to the principal axis of zinc (2.907 Å) and in a plane perpendicular to the principal axis (2.6995 Å for the separation distance between planes). The half-widths of the angular distribution curves were found to be $b_{\parallel} = 36$ mm and $b_{\perp} = 31$ mm at 90°K, and $b_{\parallel} = 42$ mm and $b_{\perp} = 37$ mm at 300°K. Thus, the anisotropy is ~13%. An identical value for the anisotropy of ~13% was also obtained by using the Sommerfield model of a metal. Physical properties of the zinc single crystal such as the magnetic susceptibility, which are due to the electron momentum, should also be anisotropic. It is shown that there is a qualitative correspondence between the anisotropy of the magnetic susceptibility and the anisotropy of the maximum electron momentum. (TTT)

5935 PROPERTIES OF POSITRONS: SOME RESULTS OBTAINED WITH MONOCHROMATIC PHOTONS IN THE DOMAIN OF PHOTONUCLEAR REACTIONS. J. Miller, C. Schuhl, and C. Tzara (Centre d'Études Nucléaires, Saclay, France). J. phys. radium, 22: 529-34(Oct. 1961). (In French)

The specific properties of positrons, compared to those of negatrons, make possible the study of photonuclear reactions with the aid of monochromatic photons. Results obtained by this method dealing with (γ,n) reactions on various elements and elastic scattering of photons on some of them are discussed. (auth)

5936 RESONANT SCATTERING OF PHOTONS: GIANT RESONANCE IN C^{12}, Al^{27}, AND Ca^{40}. A. Bussière de Nercy (Faculté des Sciences, Orsay, France). J. phys. radium, 22: 535-7(Oct. 1961). (In French)

The giant resonance in C^{12}, Al^{27}, and Ca^{40} is by resonant scattering of bremsstrahlung γ rays. The angular distributions of the scattered photons are dipolar. The results are compared with (γ,n) and (γ,p) cross sections and absorption cross sections. (auth)

5937 RESEARCH ON THE RECOILLESS γ EMISSION FOLLOWING COULOMB EXCITATION OF Fe^{57}. E. Cotton, J. Gastebois, and J. L. Picou (Centre d'Études Nucléaires, Saclay, France). J. phys. radium, 22: 538-9(Oct. 1961). (In French)

Coulomb excitation of the 136 kev level of Fe^{57} was produced by 4 Mev α particles. Absorption of the 14.4-kev cascade γ ray by absorbers enriched in Fe^{56} and Fe^{57} and of about the same thickness were compared. No Mössbauer effect was seen (<5%). (auth)

5938 SCATTERING OF ELECTRONS BY O^{16} AND O^{18}. F. Lacoste and G. R. Bishop (École Normale Supérieure, Orsay, France). J. phys. radium, 22: 540(Oct. 1961). (In French)

The cross sections for elastic scattering of 150-Mev electrons by O^{16} and O^{18}, and for inelastic scattering of 150-Mev electrons by O^{18} with an excitation energy of 6 Mev, are measured at angles of 60 to 110°. The results yield the difference between the harmonic-well potential parameters for the two nuclides studied, as follows: given that $a_{18} = (1 + \epsilon)a_{16}$, the experiment yields $\epsilon = (2.5 \pm 0.6) \times 10^{-2}$. Further, the experiment yields the lifetime of the 1.97-Mev excited state of O^{18} to be $(3.3 \pm 1.5) \times 10^{-12}$ sec. (T.F.H.)

5939 CONTRIBUTION TO THE STUDY OF THE S^{32} NUCLEUS. G. R. Bishop and G. A. Proca (École Normale Supérieure, Orsay, France). J. phys. radium, 22: 541-3 (Oct. 1961). (In French)

Experiments on the nucleus S^{32} are undertaken in order to determine the matrix element of the transition to the second excited state. It is shown that the transition considered is certainly not electric quadrupole but is perhaps electric monopole. (auth)

5940 EXCITATION OF THE 15.1 AND 16.1 MEV LEVELS OF THE C^{12} NUCLEUS BY ELECTRON SCATTERING. B. Dudelzak and R. E. Taylor (École Normale Supérieure, Orsay, France). J. phys. radium, 22: 544-7 (Oct. 1961). (In French)

The spectrum of electrons scattered at 135° from a carbon target is studied as a function of incident electron energy. For several incident energies between 46 and 154 Mev, the elastic peak and the region of the spectrum from 13.5 to 17.5 Mev below the elastic peak are measured. Peaks are observed corresponding to excitation of the 15.1- and 16.1-Mev levels. The cross sections for these excitations, relative to the elastic peak, are determined to an accuracy of the order of 15%. The cross section for excitation of the 15.1-Mev level falls from 2.6×10^{-32} cm^2/steradian to 0.4×10^{-32} cm^2/steradian as the energy increases from 46 to 100 Mev. The cross section for excitation of the 16.1 Mev level varies little with energy, and is the order of 0.5×10^{-32} cm^2/steradian for the energies studied. (auth)

5941 STUDY OF THE EXCITATION OF O^{16} BY INELASTIC SCATTERING OF ELECTRONS. D. B. Isabelle and G. R. Bishop (École Normale Supérieure, Orsay, France). J. phys. radium, 22: 548-51(Oct. 1961). (In French)

The spectrum of electrons inelastically scattered from water targets is examined, with emphasis on the region of excitation known as the giant resonance in oxygen. It is shown that the giant resonance is formed by two principal electric dipole transitions, with excitation energies and relative intensities in agreement with theoretical estimates. Two bands of excitation at energies equal to twice the energies of the giant resonance transitions are also observed. An experimental form factor is calculated for these transitions, which permits a multipole assignment. (auth)

5942 STUDY OF THE GIANT RESONANCE IN Ca^{40} BY INELASTIC SCATTERING OF ELECTRONS. J. P. Perez Y Jorba (Laboratoire de l'Accélérateur Linéaire, Orsay, France and Faculté des Sciences, Bordeaux) and H. Hguyen Ngoc. J. phys. radium, 22: 551-4(Oct. 1961). (In French)

The giant resonance in Ca^{40} is studied by inelastic electron scattering. Structure in the resonance is observed, in agreement with theoretical predictions. The cross section for photonuclear absorption, integrated over the region of the giant resonance, is determined using the method of virtual quanta. (auth)

5943 THE SPECTRUM OF HIGH-ENERGY ELECTRONS INELASTICALLY SCATTERED FROM CARBON. AN ATTEMPT AT INTERPRETATION. P. Bounin and G. R. Bishop (École Normale Supérieure, Orsay, France). J. phys. radium, 22: 555-9(Oct. 1961). (In French)

The inelastic spectrum of 194 Mev electrons scattered at 135° from a carbon target is determined experimentally. The principal characteristic is a large so-called "quasi-elastic" peak, which is caused by the direct interaction of electrons with nucleons within the nucleus. An interpretation based on the harmonic oscillator gives a theoretical curve that has the same form as the experimental curve. (auth)

5944 STUDY OF CERTAIN REACTIONS (d,γ) IN THE REGION OF EXCITATION OF THE GIANT RESONANCES. M. Suffert, D. Magnac-Valette, and J. Yoccoz (Centre de Recherches Nucleaires, Strasbourg). J. phys. radium, 22: 565-8(Oct. 1961). (In French)

Using direct observation of γ transitions in nuclei excited at about 20 Mev by deuterons, the cross sections of the reactions $Be^9(d,\gamma)B^{11}$, $B^{11}(d,\gamma)C^{13}$, $N^{14}(d,\gamma)O^{16}$, and $F^{19}(d,\gamma)Ne^{21}$ are measured at incident energies varying from 1 to 5.6 Mev. (auth)

5945 EXCITED STATES IN Be^8. R. Bilwes, B. Bourotte, and D. Magnac-Valette (Centre de Recherches Nucleaires, Strasbourg). J. phys. radium, 22: 568-9(Oct. 1961). (In French)

A study is made of the 16.67-Mev excited level of Be^8. Preliminary results indicate a 2α de-excitation of this level. (auth)

5946 PROTON ANGULAR DISTRIBUTIONS AND (p,γ) ANGULAR CORRELATIONS IN THE REACTION $B^{11}(d,p)B^{12}$. S. Gorodetzky, A. Gallmann, P. Fintz, and G. Bassompierre (Institut de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: 573-5(Oct. 1961). (In French)

Measurement at $E_d = 5.5$ Mev of the angular distribution of protons from the reaction $B^{11}(d,p)B^{12}$ going respectively to the ground state and the first and second excited states confirms the respective values $l_n = 1, 1$, and 0. The parities of these levels are therefore respectively +, +, and –. Analysis of the p-γ angular correlation in the d-p plane for the first excited level (0.95 Mev) of B^{12} allows the exclusion of the value $J = 0$ for the angular momentum of this level. The only possibilities are $J = 1^+$ or 2^+ with a mixture of multipolarities for the 0.95-Mev gamma transition, or $J = 3^+$ with pure E2 radiation. (auth)

5947 SPECTROGRAPHY OF PROTONS FROM THE REACTION $C^{12}(d,p)C^{13}$ AND STUDY OF THE 5.51 AND 6.10-Mev LEVELS OF C^{13}. S. Gorodetzky, A. Gallmann, P. Fintz, and G. Bassompierre (Institut de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: 575-7(Oct. 1961). (In French)

The protons from the reaction $C^{12}(d,p)C^{13}$ at $E_d = 5.5$ Mev were analyzed with a broad-range magnetic spectrograph. No group of protons with intensity greater than 0.5% of the intensity of the group of protons corresponding to the 3.85 Mev level in C^{13} appeared in the positions of the expected 5.51 and 6.10 Mev levels of C^{13}. (auth)

5948 STUDY OF THE TRANSITIONS IN THE REACTION $C^{12}(d,p)C^{13}$ BY MEANS OF AN INTERNAL PAIR SPECTROMETER. S. Gorodetzky, G. Frick, and A. Gallmann (Institut de Recherches Nucleaires, Strasbourg). J. phys. radium, 22: 578-9(Oct. 1961). (In French)

An intermediate-focusing electron spectrometer is converted into an internal pair spectrometer. Its operation is tested using the monopolar transition of O^{16}. The energy of the transitions to the ground level from the first three excited states of C^{13} was measured. The levels in question, 3.09, 3.68, and 3.86 Mev, are reached by the reaction $C^{12}(d,p)C^{13}$. (auth)

5949 REACTION (d,α) ON CARBON-12. J. Gastebois, J. Jastrzebski, J. L. Picou, J. Quidort, and J. P. Schapira (Centre d'Études Nucléaires, Saclay, France). J. phys. radium, 22: 580-1(Oct. 1961). (In French)

Junction diodes are used in the detection of α particles from $C^{12}(d,\alpha)B^{10}$ and $C^{12}(d,\alpha)B^{10*}$ reactions at 4.7 Mev. (auth)

5950 STUDY OF THE REACTION $Li^7(He^3,\alpha)Li^6$ IN THE VICINITY OF 5 Mev. J. Linck, I. Nicolas, R. Bilwes, and D. Magnac-Valette (Centre de Recherches Nucleaires, Strasbourg). J. phys. radium, 22: 581-2(Oct. 1961). (In French)

A 9.3-Mev level for He^3 of 5 Mev energy is found. A shift of the 7.40-Mev level toward lower excitation is also found, implying the existence of a non-separated level, perhaps at 6.63 Mev. (auth)

5951 STUDY OF THE REACTION $B^{11}(He^3,t)C^{11}$ AND THE COMPETITIVE REACTION $B^{11}(He^3,\alpha)B^{10}$. B. Bourotte, I. Nicolas, R. Bilwes, and D. Magnac-Valette (Centre de Recherches Nucleaires, Strasbourg). J. phys. radium, 22: 583-4(Oct. 1961). (In French)

In 5-Mev He^3-induced reactions in B^{11}, tritons emitted at 30° are not found. However, excited levels in B^{10} appear in the magnetic spectrograph spectrum at 3.58, 4.77, 5.13 (a mixture of 5.11 and 5.16 Mev), and 6 Mev (mixture of 5.92, 6.02, and 6.16 Mev). Higher levels appear at 6.57, 7.56, 7.78, and 8.07 Mev. (auth)

5952 STUDY OF CERTAIN REACTIONS PRODUCED BY Li^6 IONS ON Be. M. Coste (Faculté des Sciences, Bordeaux), C. Lemeille, L. Marquez, and N. Saunier. J. phys. radium, 22: 584-6(Oct. 1961). (In French)

Alpha particles produced in the reaction $Li^6 + Be^9 \rightarrow \alpha + B^{11}$ are studied by means of nuclear plates. Groups α_0, α_1, α_2, α_3, α_{4+5}, α_6, and α_7 of α particles are identified. (auth)

5953 THE MECHANISM OF THE REACTION $Be^9(Li^6,2\alpha)Li^7$ (FIRST EXCITED STATE). C. Lemeille, L. Marquez, and N. Saunier (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 586-9(Oct. 1961). (In French)

The irradiation of Be^9 by 2-Mev Li^6 ions produces Li^7 in its first excited state of 479 kev. Measurements are made of the charged particles in coincidence with the 479-kev gamma rays. The observations agree with the following mechanism: $Li^6 + Be^9 \rightarrow \alpha_1 + B^{11*}$, $B^{11*} \rightarrow \alpha_2 + Li^{7*}$, and $Li^{7*} = Li^7 + \gamma$; or $B^{11*} = n + B^{10*}$, $B^{10*} = B^{10} + \gamma$. (auth)

5954 OBSERVATION OF SOME NUCLEAR REACTIONS PRODUCED BY Li^6 IONS ON CARBON. L. Marquez and Pham-Dinh-Lien (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 589-91(Oct. 1961). (In French)

The nuclear reactions produced by Li^6 ions of energy up to 2 Mev on C^{12} are studied. The reaction $C^{12}(Li^6,\alpha)N^{14}$ seems to be the dominant one. (auth)

5955 THE MEASUREMENT OF SOME (n,α) CROSS SECTIONS IN THE NEUTRON ENERGY RANGE FROM 12 TO 19.6 Mev. M. Bormann, S. Cierjacks, R. Langkau, H. Neuert, and H. Pollehn (Universität, Hamburg). J. phys. radium, 22: 602-4(Oct. 1961). (In French)

Cross sections for the reactions $Al^{27}(n,\alpha)Na^{24}$, $V^{51}(n,\alpha)Sc^{48}$, $Co^{59}(n,\alpha)Mn^{56}$, and $Co^{59}(n,2n)Co^{58}$ were measured for neutron energies between 12 and 19.6 Mev, using neutrons of the $d(T,n)\alpha$-reaction at $E_d = 3$ Mev. (auth)

5956 STUDY BY γ-RAY DETECTION OF THE EXCITATION FUNCTION OF REACTIONS PRODUCED BY PROTONS ON V^{51}. Y. Cassagnou, J. M. F. Jeronymo, C. Levi, L. Papineau, and D. Stanojevic (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 604-7(Oct. 1961). (In French)

Levels up to 3 Mev excitation in Cr^{51} are given and a partial disintegration scheme is obtained. The excitation functions of γ rays show a resonant structure. The mean level spacing of Cr^{52} at 14.8 Mev excitation is found to be about 1 kev. Total $V^{51}(p,n)Cr^{51}$ cross section determination at 4.26 Mev proton energy gives 220 ± 30 mb. (auth)

5957 EXCITATION OF THE SECOND LEVELS OF Zn^{64}, Zn^{66}, AND Zn^{68} BY INELASTIC SCATTERING OF α PARTICLES. R. Chaminade, M. Crut, H. Faraggi, D. Garreta, J. Saudinos, and J. Thirion (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 607-9 (Oct. 1961). (In French)

A study of the angular distributions of alpha particles exciting the second 2^+ state of Zn^{64}, Zn^{66}, and Zn^{68} was made, using 43-Mev alpha particles. Comparison with the elastic angular distributions showed that in the cases of Zn^{64} and Zn^{66} the transition $(0^+ \rightarrow 2^+)$ was not direct, but should be interpreted as a double excitation process. For Zn^{68} the two processes (direct and double excitation) competed. (auth)

5958 PROTON, DEUTERON, TRITON, AND HELIUM NUCLEI EMISSION BY Au^{197} BOMBARDED WITH 154-Mev PROTONS. Jeannine Génin, Pierre Radvanyi, Ivan Brissaud, and Claude Detraz (Faculté des Sciences, Orsay, France). J. phys. radium, 22: 615-17(Oct. 1961). (In French)

Charged energetic particles, emitted by Au^{197} bombarded by 154-Mev protons, were studied with a $(dE|dx - E)$ scintillation telescope. Energy spectra of protons, deuterons, and tritons above 30 Mev were measured at 15, 30, and 60° and compared with those obtained for carbon. Indications were also given for the production of He^3 and He^4 nuclei above 85 Mev. The different mechanisms leading to the formation of energetic deuterons were discussed. (auth)

5959 REMARKS ON SOME NUCLEAR REACTIONS CAUSED BY DIRECT INTERACTIONS AT ENERGIES AROUND 100 Mev. P. Benoist-Gueutal (Laboratoire de Physique Nucléaire, Orsay, France). J. phys. radium, 22: 618-21(Oct. 1961). (In French)

The nuclear reactions (p,2p), (p,pn), (p,d), (p,dn) and (p,dp) in the energy range around 150 Mev are analyzed from the viewpoint of the momentum distribution of nucleons in nuclei. (auth)

5960 REACTION (p,2p) ON C^{12} AT 155 Mev. J. P. Garron, J. C. Jacmart, M. Riou, and Ch. Ruhla (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). J. phys. radium, 22: 622-7(Oct. 1961). (In French)

For the reaction $C^{12}(p,2p)B^{11}$ the summed-energy spectra are measured with two scintillation telescopes, for coplanar scattering between 28 and 70°, when the two protons are emitted at equal angles relative to the incident beam and with almost the same energy. The spectra show two well-defined peaks, which can be interpreted as those in which a proton is knocked out respectively from the p-shell and s-shell in the carbon. From the angular distributions the momentum distribution of the p and s protons can be deduced. These distributions are in agreement with the distributions that can be calculated from the harmonic oscillator model, using different parameters for the two states. (auth)

5961 STUDY OF REACTIONS $(p,p'\gamma)$ AT 151 Mev. CASE OF THE 15.1-Mev LEVEL OF C^{12}. X. de Bouard, H. Langevin-Joliot, N. Marty, and B. Tatischeff (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). J. phys. radium, 22: 631-3(Oct. 1961). (In French)

Excitation of the 15.1-Mev level of C^{12} by scattering of 151-Mev protons is studied by coincidence between protons and de-excitation γ rays. The angular distribution of protons in coincidence with γ rays in the recoil nucleus direction, the correlation between protons scattered at 8° and γ rays, and the inelastic scattering cross section at 8° are given. (auth)

5962 THEORETICAL STUDY OF THE REACTION $(p,p'\gamma)$ AT HIGH ENERGIES. APPLICATION TO THE 15.1-Mev LEVEL OF C^{12}. Giu Do Dang (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). J. phys. radium, 22: 633-5(Oct. 1961). (In French)

A general formula for the cross section and angular correlation is derived for the reaction $(p,p'\gamma)$ with high energy protons on light nuclei, using direct interaction theory with a central potential and Born approximation. Comparison with experimental results is made for the 15.1-Mev level of C^{12}. (auth)

5963 REACTIONS (p,pn) AT MEDIUM ENERGIES. M. Gusakow, G. Albouy, N. Poffé, and C. Riehl (Faculté des Sciences, Orsay, France). J. phys. radium, 22: 636-8(Oct. 1961). (In French)

The excitation functions for (p,pn) reactions on F, Na, Mn, Cs, Y, and Au are measured for protons between 20 and 155 Mev. The results are compared with theoretical calculations. The experimental values are all higher than the calculated ones. (auth)

5964 EXCITATION FUNCTIONS OF REACTIONS (p,xn) ON Au BETWEEN 40 AND 155 Mev. N. Poffe, G. Albouy, M. Gusakow, and J. L. Sarrouy (Faculté des Sciences, Orsay, France). J. phys. radium, 22: 639-41 (Oct. 1961). (In French)

Mercury isotopes of mass between 197 and 190 that were produced in proton reactions on gold are separated by electromagnetic deflection. Results have been normalized with regard to Hg^{195}, which appears at all energies, the excitation function of which has been determined independently. (T.F.H.)

5965 PRELIMINARY RESEARCH ON SOME PRIMARY INTERACTIONS, INVOLVED IN NUCLEAR REACTIONS PRODUCED BY 200-Mev Ne^{20} IONS, BY THE IONOGRAPHIC METHOD. Pierre Cuer, Raymond Pfohl, and Christiane Gegauff (Centre de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: 641-4(Oct. 1961). (In French)

The possible influence of temporary nuclear structures was investigated in primary interactions of heavy ions. Ilford C_2 and G_5 emulsions were exposed to 200-Mev Ne^{20}, and were scanned for events where particles of $Z = 1$ and $Z = 2$ were emitted forward with energy much higher than evaporation energies. The $Z = 1$ spectrum was wide and had a high proportion of deuterons and tritons ranging up to 80 Mev. Ten interactions out of 2000 where $E_\alpha > 55$ Mev were explained by a kind of stripping where it was necessary to assume substructures during the time of interaction. (auth)

5966 REACTIONS OF 200-Mev Ne^{20} IONS WITH THE CONSTITUENTS OF AN IONOGRAPHIC EMULSION. Raymond Pfohl, Christiane Gegauff, and Jean-Pierre Lonchamp (Centre de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: 644-7(Oct. 1961). (In French)

Nuclear plates are exposed to 200-Mev Ne^{20}. The reaction cross section is calculated for each number of prongs from statistics of 1000 stars. The excitation functions are given. The maximum of the prong distribution is around 4 prongs. The ratio of the number of α tracks to proton tracks is approximately 1.6 for reactions with heavy nuclei and increases with the prong number from 2.5 to 6 for reactions with light nuclei. The discrimination between α particles and protons is made with diluted Ilford C2 emulsions. (auth)

5967 CROSS SECTION FOR THE SCATTERING OF SLOW NEUTRONS BY THE HYDROGEN NUCLEUS IN METALLIC HYDRIDES. R. Genin and M. Ribrag (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 648-50(Oct. 1961). (In French)

Measurements are made of total cross sections of zirconium, tantalum, and lanthanum hydrides, as a function of neutron energy. The interpretation of these results is given in terms of a very simple model. (auth)

5968 CROSS SECTIONS FOR THE REACTIONS $F^{19}(n,2n)F^{18}$ AND $N^{23}(n,2n)Na^{22}$. C. Williamson and J. Picard (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 651(Oct. 1961). (In French)

The cross sections are measured in the neutron energy range 12.5 to 21 Mev by the activation method. The results are compared with the predictions of the statistical theory. Experimental results are given. (auth)

5969 TOTAL CROSS SECTIONS FOR 28.4-Mev NEUTRONS. G. Deconninck, A. Gonze, P. Macq, and J. P. Meulders (Centre de Physique Nucléaire, Louvain, Belg.). J. phys. radium, 22: 652-5(Oct. 1961). (In French)

Neutron total cross sections in the 28.4-Mev energy region are measured by a transmission method for $27 \leq A \leq 238$. The experimental curve is well fitted by theoretical calculations. (auth)

5970 ANOMALY IN THE β-SPECTRUM OF P^{32}. P. Depommier and M. Chabre (Université, Grenoble, France and Centre d'Etudes Nucléaires, Grenoble, France). J. phys. radium, 22: 656-9(Oct. 1961). (In French)

The β spectrum of P^{32} is measured, using an intermediate image spectrometer. The shape factor is nearly linear, decreasing by 8% between 250 and 1600 kev. If the transition is considered as 1-forbidden, a V-1.21 A interaction seems sufficient to interpret the data. An important contribution from the pseudoscalar interaction is dubious. No conclusion can be drawn concerning the conserved vector current theory. As a test of the spectrometer, the β spectrum of Na^{24} is determined within 0.5% between 300 and 1300 kev. (auth)

5971 STUDY OF THE β-γ CASCADE IN THE DEEXCITATION OF Rb^{86}. J. P. Deutsch, L. Grenacs, J. Lehmann, and P. Lipnik (Université, Louvain, Belg.). J. phys. radium, 22: 659-62(Oct. 1961). (In French)

Spectrum-shape and beta-gamma directional correlation measurements on Rb^{86} are described. Results are inconsistent with the results of the application of the modified B_{ij}-approximation to the transition under consideration. (auth)

5972 EXPERIMENTAL STUDY OF THE β-γ CASCADE IN Ce^{141}. J. P. Deutsch, L. Grenacs, and P. Lipnik (Université, Louvain, Belg.). J. phys. radium, 22: 662-5 (Oct. 1961). (In French)

Spectrum-shape and beta-gamma directional and circular polarization correlations were measured on the 70% 432-kev beta-group of Ce^{141}. Within errors, the shape was found to be statistical and the directional correlation zero. Thus the "ξ-approximation" seems to be valid for this transition. The circular polarization interpreted on this basis furnishes limits for the value of some elements of the transition matrix. (auth)

5973 CONTRIBUTION TO THE STUDY OF THE NUCLEAR DECAY SCHEME OF Sm^{151}. R. Chéry (Faculté des Sciences, Lyon). J. phys. radium, 22: 665-8(Oct. 1961). (In French)

The β and γ radiation in the transition $Pm^{151} \rightarrow Sm^{151}$ is studied. The γ spectra decomposition indicates components of 65, 100, 170, 205, 240, 275, 340, 440, 650, and 715 kev. The β spectra are built up of five components of maxima energy 1300, 115, 960, 860, and 485 kev. The study of $\beta\gamma$ and $\gamma\gamma$ coincidences leads to excited levels of Sm^{151} at 65, 100, 165, 340, 440, 750, and 815 kev. The upper limits for the lifetimes of levels at 65 and 100 kev are 5×10^{-10} and 10^{-9} sec respectively. The angular correlation coefficients of the following sequences are: 275 kev–65 kev: $A_2 = 0.090 \pm 0.011$, $A_4 = 0.078 \pm 0.011$; 240 kev–100 kev: $A_2 = 0.080 \pm 0.017$, $A_4 = 0.062 \pm 0.018$; and 175 kev–165 kev: $A_2 = 0.180 \pm 0.080$, $A_4 = -0.057 \pm 0.081$. Finally for levels 0, 65, 100, 165, and 340 kev of Sm^{151}, the spins proposed are $^7/_2$, $^9/_2$, $^9/_2$, $^7/_2$, and $^7/_2$. (auth)

5974 LIFETIME OF EXCITED LEVELS OF Eu^{155}. M. Vergnes and J. Jastrzebski (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). J. phys. radium, 22: 669-71(Oct. 1961). (In French)

The lifetime of the second excited state (1.2 ns) of Eu^{155}; obtained by the β^- disintegration of Sm^{155}, is measured. A limiting value (0.4 ns) is found for the first excited state. The measured E1 transition probabilities are compared with theoretical predictions. (auth)

5975 TRANSITIONS IN THE ODD-ODD NUCLEI Au^{190} AND Au^{192}. Jerzy Jastrzebski and Pierrette Kilcher (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). J. phys. radium, 22: 672-4(Oct. 1961). (In French)

The method used for the study of the conversion electron spectrum of the odd-odd nuclei Au^{190} and Au^{192} is described. Preliminary results are given for two corresponding transitions in these nuclei. (auth)

5976 CORRECTION FACTOR IN THE β-SPECTRUM OF Au^{198}. M. Chabre and P. Depommier (Université, Grenoble, France and Centre d'Etudes Nucléaires, Grenoble, France). J. phys. radium, 22: 674-6(Oct. 1961). (In French)

The shape factor of the main β transition in Au^{198} is represented well by the formula $C = [1 + g(W_0 - W)]^2$ with $g = 0.034 \pm 0.004$ and $W_0 = (962 \pm 1)$ kev. The investigation is carried out with an intermediate-image spectrometer (resolution: 2.5%) and vacuum-evaporated sources. (auth)

5977 STUDY OF THE AUGER L ELECTRONS FOLLOWING THE AUTOIONIZATION PHENOMENON IN Po. A. Juillard and A. Moussa (Centre d'Etudes Nucléaires, Grenoble, France). J. phys. radium, 22: 677-9(Oct. 1961). (In French)

A study is carried out of the rearrangement Auger L electrons following the autoionization process after α disintegration of Po^{210}. Experimental results are between 1.3×10^{-3} to 2.5×10^{-3} Auger L electrons per disintegration. These results are compared with measurements of rearrangement X-K and X-L photons and with the theoretical value. (auth)

5978 γ-γ AND γ-α ANGULAR CORRELATIONS FOR SOME ELEMENTS IN THE Pa^{231} FAMILY. F. Bragança Gil and G. Y. Petit (Laboratoire de Physique Nucléaire, Orsay, France and Faculté des Sciences, Bordeaux). J. phys. radium, 22: 680-2(Oct. 1961). (In French)

Angular correlation data between γ-γ and α-γ radiations seem favorable to the following transitions: Ac^{227}(327 kev) ($^3/_2$) 300-kevγ → Ac^{227}(27 kev) ($^1/_2$ or $^5/_2$) 27-kevγ → Ac^{227}($^3/_2$); Rn^{219}($^3/_2$) 6.544-Mevα Po^{215}(272 kev) ($^5/_2$) 272-kevγ → Po^{215}($^1/_2$); Rn^{219}($^3/_2$) α → Po^{215}(401 kev) ($^3/_2$) 401-kevγ → Po^{215}($^1/_2$); and Bi^{211}($^9/_2$−) 6.272-Mevα → Tl^{207}(350 kev) ($^3/_2$+) 350-kevγ → Tl^{207}($^1/_2$+). (auth)

5979 THE DISINTEGRATION OF MESOTHORIUM-1. PROPOSALS FOR DECAY SCHEMES. J. Tousset and A. Moussa (Institut de Physique Nucléaire, Lyon and Faculté des Sciences, Grenoble, France). J. phys. radium, 22: 683-5(Oct. 1961). (In French)

The observation of low energy conversion lines and the Kurie plot lead to several possible decay schemes for Ra^{228}. Experimental difficulties prevent a definite choice between them. (auth)

5980 OUTLINE OF THE 0 + EXCITED STATES. J. Yoccoz (Faculté des Sciences, Strasbourg). J. phys. radium, 22: 685-7(Oct. 1961). (In French)

A theoretical and experimental study is made of the first 0 + levels in near-magic, magic, and doubly magic nuclei C^{12}, O^{16}, Ca^{40}, Ge^{70}, Ge^{72}, Zr^{90}, and Po^{214}. Collective models (α, vibrational, and hydrodynamic models) and one- and two-particle excitation models for these states are considered. Information that can be derived from the empirical nuclear monopole matrix element, regarding e.g. nuclear Coulomb excitation by electrons or disintegration by pairs or internal conversion, is discussed. The use of data regarding two-photon emission, in order to choose between possible configurations for the states under consideration, is described. (T.F.H.)

5981 SEARCH FOR TWO-PHOTON DE-EXCITATION IN THE MONOPOLE TRANSITIONS IN O^{16}, Ca^{40}, AND Zr^{90}. S. Gorodetzky, G. Sutter, R. Armbruster, P. Chevallier, P. Mennrath, F. Scheibling, and J. Yoccoz. J. phys. radium, 22: 688-9(Oct. 1961). (In French)

A search is made for two-photon de-excitation in monopole transitions in O^{16}, Ca^{40} and Zr^{90}. Upper limits of the probabilities for the phenomena are given as $P_{\gamma\gamma}/P_\pi \leq 6 \times 10^{-3}$ and 7×10^{-3} respectively for O^{16} and Ca^{40}, and $P_{\gamma\gamma}/P_\pi + P_e^- \leq 1.4 \times 10^{-3}$ for Zr^{90}. (auth)

5982 LIFETIME OF THE 418-kev SECOND EXCITED STATE OF Al^{26}. S. Gorodetzky, R. Richert, R. Manquenouille, and A. Knipper (Institut de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: 690-1(Oct. 1961). (In French)

The half life of the second excited level at 418 kev in Al^{26} is found to be 1.23×10^{-9} sec. (auth)

5983 MEASUREMENT OF THE MEAN LIFETIMES OF EXCITED LEVELS BY MEANS OF A PULSED PROTON-BEAM. Jean-Jacques Samueli and Armand Sarazin (Institut d'Etudes Nucléaires, Algiers). J. phys. radium, 22: 692-5(Oct. 1961). (In French)

Measurements of the lifetimes of excited nuclear states were obtained by means of a Van de Graaff 3-Mev accelerator, the beam of which was pulsed. Results were given on the levels of 122 kev of Sm^{152}, 710 kev of B^{10} and 320 kev of V^{51}. (auth)

5984 NATURE OF THE EXCITED STATES OF Co^{59}. M. Haglund (Faculté des Sciences, Bordeaux) and J. Touchard. J. phys. radium, 22: 695-7(Oct. 1961). (In French)

A weak-coupling approximation for the phonon-particle interaction is made to obtain the energies of the five low-lying excited levels between 1 and 1.45 Mev in the nucleus Co^{59}. (auth)

5985 THEORETICAL STUDY OF THE Y^{90} SPECTRUM. M. Bouten, M. Demeur, and H. Pollak (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). J. phys. radium, 22: 697-9(Oct. 1961). (In French)

The low energy spectrum of Y^{90} is theoretically investigated with zero-range force interaction. The results agree with the first six experimental levels and predict an isomeric state with spin 7+, which is found experimentally. (auth)

5986 LIFETIMES OF THE EXCITED STATES IN Tb^{159} AT 362 Kev AND IN Pb^{207} AT 570 Kev. S. Gorodetzky, R. Manquenouille, R. Richert, and A. Knipper (Institut de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: 699-701(Oct. 1961). (In French)

The following half lives are directly measured: Tb^{159}, excited level at 362 kev, $T_{1/2} = (1.6 \pm 0.16) \times 10^{-10}$ sec; and Pb^{207}, excited level at 570 kev, $T_{1/2} = (1.1 \pm 0.11) \times 10^{-10}$ sec. (auth)

5987 MAGNETIC QUADRUPOLE (M2) γ-TRANSITIONS. R. Foucher and A. G. de Pinho (Laboratoire de Physique Nucléaire, Orsay, France). J. phys. radium, 22: 701-3(Oct. 1961). (In French)

The known values of pure M2 γ transition probabilities are discussed in relation to deductions from the shell-model (classical and Nilsson) theories. (auth)

5988 INTERPRETATION OF NUCLEI WITH SPIN ½ AS ASYMMETRIC ROTORS. Jean Vervier (Centre d'Etudes Nucléaires, Mol, Belg.). J. phys. radium, 22: 704-6(Oct. 1961). (In French)

The theory on the energy levels of odd nuclei with spin ½, considered as asymmetric rotors, is compared with experimental data; agreement is generally found. (auth)

5989 DETERMINATION OF THE SPIN OF LEVELS OF In^{116} AND Hf^{178} BY RESONANT SCATTERING OF SLOW NEUTRONS. H. Ceulemans and F. Poortmans (Centre d'Etudes Nucléaires, Mol, Belg.). J. phys. radium, 22: 707-8(Oct. 1961). (In French)

Neutron resonances were measured with a slow neutron crystal spectrometer in order to determine the spin J. Results obtained are J = 5 for the 1.45-ev resonance in In^{115} + n, and J = 3 and J = 4 for the 1.1- and 2.4-ev resonances in Hf^{177} + n. (auth)

5990 TIME-OF-FLIGHT STUDY OF THE NEUTRON RESONANCES IN Rh^{103} BETWEEN 4-ev AND 10 Kev. P. Ribon, Z. Dimitrijevick, A. Michaudon, and P. Wagner (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 708-11(Oct. 1961). (In French)

The rhodium-103 total cross section is measured by the time-of-flight method, from 5 ev to 10 kev, using a B^{10} capture gamma ray detector. At high energy the resolution is 2.5 nanoseconds/meter. The results yield the resonance parameters at low energy and the level spacings. (auth)

5991 CONTRIBUTION TO THE DETERMINATION OF THE NEUTRON RESONANCE PARAMETERS OF U^{235}. A. Michaudon and P. Ribon (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 712-14(Oct. 1961). (In French)

The U^{235} fission cross section, measured by time of flight, is shape-analyzed by least-squares methods assuming that the resonances are of the Breit-Wigner one-level type broadened by the Doppler effect. σ_{0f} and Γ values are given for several resonances. In addition, the neutron transmission of U^{235} is measured between 8 and 22 ev with a resolution of 0.01 μs/m. The complete set of parameters (spin excepted) is thus obtained for five resonances. A large dispersion of Γ_γ values is observed. (auth)

5992 STUDY OF THE FLUCTUATIONS OF THE PARTIAL WIDTHS OF THE RADIATIVE TRANSITIONS IN THE NEUTRON RESONANCES OF Th^{232}. H. Nifenecker, Y. Hazoni, A. Michaudon, and D. Paya (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 714-16 (Oct. 1961). (In French)

The partial radiation widths are measured, relative to the 1-Mev excited level, in Th^{233}. This measurement is made on 7 neutron resonances of Th^{232} from 20 to 175 ev. The normalization methods used for deducing these widths are described. The most probable value of the number of degrees of freedom ν is found to be 4 and the probability that $\nu < 1$ is found to be 16%. (auth)

5993 METHODS OF ANALYZING RESONANCE PARAMETERS BY NEUTRON TIME-OF-FLIGHT TRANSMISSION EXPERIMENTS. C. Corge, V.-D. Huynh, J. Julien, J. Morgenstern, and F. Netter (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 716-18(Oct. 1961).

Use of the IBM 7090 computer for data processing of the results of neutron transmission experiments made by the time-of-flight method allows the analysis to be made in an almost completely automatic way. Moreover, the program allows the taking into account of the various corrections in partial area determination, from which resonance parameters are deduced by a least squares method. (auth)

5994 STATISTICAL PROPERTIES OF EXCITED NUCLEAR LEVELS PRODUCED BY THE INTERACTION OF RESONANCE NEUTRONS WITH Zr AND Pr. C. Corge, V.-D. Huynh, J. Julien, J. Morgenstern, and F. Netter (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 719-21(Oct. 1961). (In French)

Experiments on neutron transmission through Zr and Pr isotopes are performed, the resolution being 0.004 μs/m. The results are for nuclei near 50 and 82 neutrons in the closed shell, in the energy range below 2000 ev. Resonance parameters, values of strength function, and isotopic assignment are given for some resonances. An interference effect is found for praseodymium. (auth)

5995 STATISTICAL ANOMALIES IN THE PARTIAL WIDTHS OF ENERGETIC RADIATIVE TRANSITIONS IN THE CAPTURE OF RESONANCE NEUTRONS BY HEAVY NUCLEI. C. Corge, V.-D. Huynh, J. Julien, J. Morgenstern, and F. Netter (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 22: 722-3(Oct. 1961). (In French)

Partial width measurements of 5.2- and 6.1-Mev radiative transitions following neutron capture in Pt^{195} show a lack of fluctuations from resonance to resonance. In addition results concerning the 4.06-Mev radiative transition following neutron capture in U^{238} are obtained. Here also the lack of fluctuations is discussed. (auth)

5996 FLUCTUATIONS IN THE PARTIAL WIDTHS OF ENERGETIC RADIATIVE TRANSITIONS, IN THE CAPTURE OF NEUTRONS BY MEDIUM NUCLEI (Pr AND Ag). APPLICATION TO THE DETERMINATION OF THE CHARACTERISTICS OF THE RESIDUAL NUCLEI. C. Corge, V.-D. Huynh, J. Julien, J. Morgenstern, and F. Netter. J. phys. radium, 22: 724-5(Oct. 1961). (In French)

Fluctuations in partial widths are brought out by measurements on the three transitions of highest energies induced by neutron capture in the first three Pr resonances. In addition, a radiative transition study of neutron capture by Ag allows isotopic assignments to be made for Ag^{107} or Ag^{109} resonances according to their spins. (auth)

5997 ON THE REACTIONS Cs(γ,p) AND I(γ,p) AT 14.8 AND 17.6 Mev. Wilfrid Sebaoun (Institut du Radium, Orsay, France). J. phys. radium, 22: 735-6(Oct. 1961). (In French)

Cs and I nuclei in a CsI crystal are bombarded by the 14.8- and 17.6-Mev γ rays from the reaction $Li^7(p,\gamma)$. Given that the Z's of Cs and I are nearly equal (55 and 53 respectively) and that the (γ,p) reaction threshold for both is 6.46 Mev, it is assumed that the proton spectra and (γ,p) cross sections are nearly the same for both. The observed proton spectra are shown, and the (γ,p) cross section is calculated to be (1.51 ± 0.17) mb. (T.F.H.)

5998 ANGULAR DISTRIBUTIONS OF HIGH ENERGY GAMMA RAYS FROM THE $F^{19}(p, \gamma)Ne^{20}$ REACTION. Kiichi Etoh (Nippon Atomic Industry Group Co., Ltd., Tokyo), Kazuo Hisatake, Takatoshi Kobayashi, Kinuko Horie, Harauko Ohmura, and Yozo Nogami. J. Phys. Soc. Japan, 16: 2091-7(Nov. 1961). (In English)

The reaction $F^{19}(p,\gamma)Ne^{20}$ was studied for proton energies from 550 to 1500 kev. The 1322-kev resonance reported previously was not observed. The angular distributions of the gamma rays from Ne^{20} compound states corresponding to the E_p = 669 and 1425-kev resonances to the first excited state were isotropic within 2% in both cases. The angular distribution of the gamma ray to the first excited state of Ne^{20} at $E_p = 1090$ kev was $W(\theta) = (1 \pm 0.028) + (0.363 \pm 0.051)\, P_2(\cos\theta) - (0.019 \pm 0.069)\, P_4(\cos\theta)$. From this result the spin and parity of the 13.91-Mev state of Ne^{20} was determined to be 2^-. (auth)

5999 INELASTIC SCATTERING OF PROTONS FROM SEVERAL LIGHT ODD-EVEN NUCLEI IN THE ENERGY RANGE FROM 6.0 Mev to 7.5 Mev. Jun Kokame (Kyoto Univ.). J. Phys. Soc. Japan, 16: 2101-17(Nov. 1961). (In English)

Protons accelerated by the 105-cm cyclotron of Kyoto University were used to investigate the energy dependence of the angular distributions and reaction mechanism of inelastically scattered protons from the odd-even nuclei, B^{11}, F^{19}, Al^{27}, and P^{31} at 6.0 ~ 7.5 Mev using conventional electronic techniques. It was found that the energy dependence of the angular distribution has close relation to the excitation energy of the compound system, namely above the excitation energy of about 13 Mev in the compound system, many patterns of the angular distributions including that of the light even-even nuclei were relatively energy-independent. Total cross sections were considerably smaller than that of the neighboring even-even nuclei and less energy-dependent. In the case of F^{19} the shapes of the angular distributions suggested the existence of a direct interaction. The relative yields from the various levels of Al^{27} might have some relation to its nuclear structure in the Nilsson model. (auth)

6000 (d,α) REACTIONS ON O^{16}, N^{14} AND C^{12} BY 14.7 Mev DEUTERONS. Takuji Yanabu (Kyoto Univ.). J. Phys. Soc. Japan, 16: 2118-30(Nov. 1961). (In English)

Angular distributions of α particles resulting from $O^{16}(d,\alpha_0)N^{14}$ (ground state), $N^{14}(d,\alpha_0)C^{12}$ (ground state), $N^{14}(d,\alpha_1)C^{12}$ (first excited state), $C^{12}(d,\alpha_0)B^{10}$ (ground state), and $C^{12}(d,\alpha_1)B^{10}$ (first excited state) reactions were studied. Alpha particles from the $O^{16}(d,\alpha_0)N_{14}$, $C^{12}(d,\alpha_0)B^{10}$, and $C^{12}(d,\alpha_1)B^{10}$ reactions exhibited forward peaks and backward peaks simultaneously, while α particles from $N^{14}(d,\alpha_0)C^{12}$ reaction showed forward peaks and oscillatory behavior. Alpha particles leaving N^{14} and C^{12} nuclei in their T = 1 state were also observed in the forward angle, and the isotopic spin conservation rule seemed to be violated. The reaction mechanism is then discussed on the basis of the surface direct reaction, the compound nucleus formation and α particle clustering in the target nucleus. It is concluded that α clustering may play an important role in the (d,α) reaction. (auth)

6001 "NEW LEVEL SCHEME OF Pt^{196}". Hidetsugu Ikegami (Tokyo Univ.), Toshimitsu Yamazaki, Mitsuo Sakai, and Kazusuke Sugiyama. J. Phys. Soc. Japan, 16: 2350 (Nov. 1961). (In English)

In connection with a study of E0 transitions between the first and second 2+ states of Pt^{194} and Pt^{196}, radiations from 5.6-day Au^{196} were investigated, and a tentative decay scheme is presented. The level scheme of Pt^{196} is analogous to that of Pt^{192}. (L.N.N.)

6002 LOW-LYING EXCITED STATES IN Ba^{136}. Kazusuke Sugiyama, Hiroyoshi Sekiguchi, and Shogo Hayashibe (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 16: 2353-4(Nov. 1961). (In English)

Single and coincidence gamma spectra and gamma-gamma directional correlation were measured in cesium-136. Spin assignments of the low-lying levels in barium-136 were proposed as follows: 830 (2+), 1660 (2+), 1900 (4+), and 2240 kev (6+). No essential difference from other even-even nuclei was found, and the transition from the first to the second 2+ level had the property of E2 predominant and $B(E2: 2' \rightarrow 2)/B(E2: 2' \rightarrow 0) < 100$. (L.N.N.)

6003 TABLE OF SPECIFIC γ-RAY EMISSION. W. Marth. Kerntechnik, 3: 483-6(Nov. 1961). (In German)

The gamma dose constants of the most important nuclides produced by reactor activation are listed. The gamma dose rate is calculated for one millicurie of each isotope at 30 centimeters. (auth)

6004 TEMPERATURE DEPENDENCE OF SPIN LATTICE RELAXATION TIME OF Cl^{35} IN PURE QUADRUPOLE RESONANCE. Akira Hirai. Mem. Coll. Sci., Univ. Kyoto, Ser. A, 29: 257-66(Sept. 1961). (In English)

The spin lattice relaxation time (T_1) of Cl^{35} nuclei between quadrupole resonance levels in para-dichlorobenzene and in sodium chlorate was measured at several temperatures by the use of the 90°–90° pulse method. To analyze the obtained data, two approaches were undertaken: the first was done by following Bayer's theory and the second by Van Kranendonk's and Yoshida-Moriya's theories. Although the approaches were bold and rough, and detailed interpretations were not possible, both gave fairly satisfactory explanation for the obtained data of temperature dependence of T_1. An experiment is proposed which would decide which approach is better. (auth)

6005 NUMERICAL DIFFERENTIAL CROSS SECTIONS OF THE (p,α) REACTIONS ON Al^{27}, Mn^{55}, AND Co^{59}. Hiroshi Ogata, Hidehiko Itoh, Yoshiko Masuda, Kunio Takamatsu, Maumi Kawashima, Akira Masaike, and Isao Kumabe. Mem. Coll. Sci., Univ. Kyoto, Ser. A, 29: 267-81(Sept. 1961). (In English)

Angular distributions are measured for the reactions $Al^{27}(p,\alpha)Mg^{24}$, $Mn^{55}(p,\alpha)Cr^{52}$, and $Co^{59}(p,\alpha)Fe^{56}$ resulting in the ground and first excited states of the residual nuclei at 10.5 to 14.5 Mev, 7.6 to 12.9 Mev, and 7.7 to 14.1 Mev, respectively. The results are tabularly presented. (auth)

6006 THE BALANCE OF ENERGY IN NUCLEAR FISSION. G. N. Walton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 192: 1062-4 (Dec. 16, 1961).

Data are reviewed on mass differences between unsymmetrical and symmetrical fragments formed in fission. It is shown that an extrapolation of these known masses suggests that symmetrical fission fragments have greater mass than unsymmetrical fragments. (C.H.)

6007 ADJUSTMENT OF RELATIVE NUCLIDIC MASSES. II. $70 < A < 200$. L. A. Koenig (Max-Planck-Institut für Chemie, Mainz), J. H. E. Mattauch, and A. H. Wapstra. Nuclear Phys., 28: 1-28(1961). (In English)

Nuclidic masses are computed from all available data, using the method of least squares. Results are compiled and presented in the mass range 70 to 200. (L.N.N.)

6008 ADJUSTMENT OF RELATIVE NUCLIDIC MASSES. III. $A \geq 200$. A. H. Wapstra (Instituut voor Kernfysisch Onderzoek, Amsterdam). Nuclear Phys., 28: 29-41(1961). (In English)

The procedure used in computing nuclidic masses for $A \geq 200$ from tabulated experimental data, is described. A list of all reaction energies of some types of reactions calculated from the mass list is given. (auth)

6009 THE GROUND-STATE EQUILIBRIUM DEFORMATION IN RARE-EARTH NUCLEI. D. R. Bès and Z. Szymanski (Univ. of Copenhagen). Nuclear Phys., 28: 42-62(1961). (In English)

The ground-state equilibrium deformation of nuclei was calculated by Mottelson and Nilsson using Nilsson's single-particle model. The influence of the pairing correlations on this deformation is studied. Values of the deformation obtained when assuming uniform charge distribution are shown to be in good agreement with the corresponding deformation of the potential. The strength of the quadrupole interaction, needed to account for the empirical electric quadrupole moments, is compared with the values used in other investigations. (auth)

6010 SEARCH FOR PSEUDOSCALAR INTERACTION IN $\frac{1}{2}+ \rightarrow \frac{1}{2}-$ β-DECAY TRANSITIONS. I. MEASUREMENT OF THE LONGITUDINAL POLARIZATION OF THE β^--PARTICLES EMITTED IN THE TRANSITION ${}_{81}Tl^{207} \rightarrow {}_{82}Pb^{207}$. Sami Cuperman (Weizmann Inst. of Science, Rehovoth, Israel). Nuclear Phys., 28: 84-95(1961). (In English)

The longitudinal polarization of β rays emitted in the transition $Tl^{207} \rightarrow Pb^{207}$ ($\frac{1}{2}+ \rightarrow \frac{1}{2}-$) was measured by double Coulomb scattering. The result obtained was $P_\ell \{Tl^{207}\} = (1.04 \pm 0.25)(-v/c)$. Assuming two-component neutrino theory with a left-handed neutrino and $C_s = C_T = 0$, this result indicates that pseudoscalar interaction gives only a small contribution, if any, to β decay. (auth)

6011 ENERGY LEVELS IN THE STABLE ISOTOPES OF TITANIUM. O. Hansen (Univ. of Copenhagen). Nuclear Phys., 28: 140-7(1961). (In English)

Excitation energies of nuclear levels in the stable Ti-isotopes were determined from inelastic proton and deuteron scattering and from (d,p) reactions. New levels were found in Ti^{47}, Ti^{49}, and Ti^{50}. The (d,p) reaction Q-values and the nuclear level schemes derived from the measurements are compared to older data and are discussed briefly in terms of the quasi-particle model. (auth)

6012 ON THE DECAY OF I^{132}. H. G. Devare (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys., 28: 148-59(1961). (In English)

The beta ray spectrum from the decay of I^{132} was investigated using a magnetic lens and intermediate image-type spectrometers. A new beta group with an end-point energy of 2920 ± 40 kev landing on the first excited state of Xe^{132} was detected. The gamma spectrum was studied using a scintillation spectrometer. Relative intensities of the gamma-rays were estimated. A ground state transition was detected from a level at 2630 kev which was identified as a possible first-excited octupole vibrational state. The summing gamma spectrum is investigated with a well-type scintillation crystal. Existence of new levels in Xe^{132} at ≈ 3100 kev, ≈ 3400 kev, and ≈ 3550 kev is inferred. (auth)

6013 DETERMINATION OF THE LIFETIME OF THE 283 kev EXCITED LEVEL OF Dy^{160}. J. Burde and M. Rakavy (Hebrew Univ., Jerusalem). Nuclear Phys., 28: 172-6(1961). (In English)

The lifetime of the 4+ level at 283 kev of Dy^{160} was measured by the technique of delayed coincidences between the beta spectrum of Tb^{160} and the appropriate K conversion line following the de-excitation of this state, using a double lens coincidence spectrometer. The mean lifetime of the 283-kev level was found to be $\tau = (10.9 \pm 1.1) \times 10^{-11}$ sec. The measured ratio $B(E2; 4+ \rightarrow 2+)/B(E2; 2+ \rightarrow 0+) = 1.65 \pm 0.33$ agrees fairly well with the value 1.43 predicted by the collective model. An upper limit of $\tau < 2.5 \times 10^{-11}$ sec was also found for the 2^- level of Dy^{160} at 1264 kev using the same method. (auth)

6014 LOW ENERGY NEUTRON CROSS SECTIONS OF Dy^{164}. R. Sher, S. Tassan, E. V. Weinstock, and A. Hellsten (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 11: 369-76(Dec. 1961). (BNL-5411)

The total and activation cross sections of Dy^{164} are measured in the energy range 0.02 to 2.0 ev. The cross sections, which are not $1/\nu$ above 0.1 ev, are well represented by the single level Breit-Wigner formula for a bound level with parameters $E_0 = -1.89 \pm 0.04$ ev; $\Gamma_n^0 = 0.041 \pm 0.001$ ev; $\Gamma = 0.166 \pm 0.004$ ev; and $\sigma_0 \Gamma^2 = 4280 \pm 100$ barns ev^2. (auth)

6015 MEASUREMENT OF ν IN FAST NEUTRON FISSION OF Th^{232} AND U^{238}. H. Condé and N. Starfelt (Research Inst. of National Defense, Stockholm). Nuclear Sci. and Eng., 11: 397-404(Dec. 1961).

Using a large liquid scintillator as the fission neutron detector the number of prompt neutrons per fission, ν, for Th^{232} and U^{238} are measured at neutron energies of 3.6 and 14.9 Mev. Values for U^{238} of 2.79 ± 0.09 and 4.75 ± 0.12 and for Th^{232} of 2.42 ± 0.10 and 4.43 ± 0.13 are found at the lower and higher energies, respectively. The parameters of the equation $\bar{\nu}(E_n) = \bar{\nu}(0) + \alpha \times E_n$, where E_n is the neutron energy in Mev, are obtained by fitting a straight line to the data using the least mean square method, yielding $\bar{\nu}(E_n) = 1.87 + 0.177\ E_n$ for Th^{232} and $\bar{\nu}(E_n) = 2.30 + 0.154\ E_n$ for U^{238}. (auth)

6016 SPINS AND PARITIES OF EXCITED LEVELS IN ${}^{212}Po$. M. Giannini, D. Prosperi, and S. Sciuti (Centro di Studi Nucleari della Casaccia, Rome and Università, Rome). Nuovo cimento (10), 22: 31-9(Oct. 1, 1961). (In English)

Spins and parities of excited levels in Po^{212} are evaluated by the comparison of log ft values, conversion coefficients, and transition probability data. Spins and parities of the 1513 and 1800-kev levels were evaluated by angular correlation measurements. All the available data show unambiguously that the first three excited levels are 2^+, 2^+, 1^+. Some uncertainties still remain for the 1680-kev level $(0^+, 2^+)$ and for the 1800-kev level (2^+). (auth)

6017 ENERGY SPECTRUM OF PHOTONEUTRONS FROM COBALT. V. Emma (Università, Catania, Italy; Centro Siciliano di Fisica Nucleare, Catania, Italy; and Istituto Nazionale di Fisica Nucleare, Catania, Italy), C. Milone, A. Rubbino, S. Jannelli, and F. Mezzanares. Nuovo cimento (10), 22: 135-44(Oct. 1, 1961). (In English)

The energy spectrum of the photoneutrons emitted at 90° from cobalt irradiated by a collimated 30-Mev Bremsstrahlung beam is studied by recording the protons recoil tracks in L-4 Ilford photoemulsions 400 μm thick. The neutron spectrum is analyzed in neutron energy steps of 0.5 Mev, starting from $E_{n\ min} = 2$ Mev. A maximum around $E_n = (4 \div 5)$ Mev in the experimental spectrum gives evidence of a contribution of other processes besides the evaporation. The interpretation of the experimental results is discussed. (auth)

6018 COMPARISON OF THREE EQUATIONS FOR THE SPACING OF NUCLEAR LEVELS. Y. P. Varshni (National Research Council, Ottawa). Nuovo cimento (10), 22: 145-57(Oct. 1, 1961). (In English)

The equations of Bethe, Weisskopf, and of Lang and Le Couteur for the spacing of nuclear levels have been compared using the experimental data for 40 nuclei. The average errors obtained by the three equations are fairly consistent. Bethe's equation was found to give the best results. Odd-even effects on the pre-exponential constants in the three equations were discussed. (auth)

6019 ON REACTION CROSS-SECTIONS WITH 14 MeV NEUTRONS. N. B. Gove and R. Nakasima (National Research Council, Washington, D. C.). Nuovo cimento (10), 22: 158-67(Oct. 1, 1961). (In English)

Cross sections with 14-Mev neutrons for light- and medium-weight nuclei are analyzed in terms of the compound nucleus model. The marked regularity in (n,p) cross-sections, pointed out by Gardner and by Levkovskii, can be reproduced fairly well. A systematic trend is found in the variation of $\sigma(n,2n)$ with the neutron number of the target nucleus. This is also analyzed in terms of the compound nucleus model. (auth)

6020 ANALYTIC PROPERTIES OF OFF-ENERGY SHELL POTENTIAL SCATTERING AMPLITUDES. D. I. Fivel (Univ. of Pennsylvania, Philadelphia). Nuovo cimento (10), 22: 326-51(Oct. 16, 1961). (In English)

A proof is given that a double dispersion relation in the momentum transfer and outgoing energy holds for off-energy-shell scattering by a Yukawa potential in which the incoming energy is held fixed and real. It is shown that unitarity then determines the off-shell in terms of the on-shell amplitude. The analytic properties of the off-shell amplitude on unphysical Riemann sheets are described and some results on the domain of holomorphy in both energy variables are also included. (auth)

6021 THE MASS DIFFERENCE OF THE NEUTRAL K-MESONS AND THE VALIDITY OF THE PERTURBATION EXPANSION IN THE THEORY OF WEAK INTERACTIONS. J. Nilsson (CERN, Geneva). Nuovo cimento (10), 22: 414-26(Oct. 16, 1961). (In English)

In the V-A theory of weak interactions, the selection rule $\Delta S \leq 1$ requires that the mass difference of the neutral K-mesons must be a second order effect in the weak interactions. This mass difference is experimentally established. The experimental value of the mass difference could possibly give an estimate of the size of the cut-off that enters the theory of weak interactions in order to make the individual terms in the perturbation expansion finite. The effective cut-off for K^0 processes involving bosons is expected to be influenced by the strong interaction cut-off, which is of the order of the nucleon mass. It is shown that the cut-off compatible with the observed value of $|\Delta m(K_1^0 - K_2^0)|$ is of the order of a few nucleon masses within two different schemes for the theory of weak interactions, and the possible implications of these results are discussed. The two schemes both lead to the result that the K_2^0 meson is heavier than the K_1^0 meson. (auth)

6022 DETERMINATION OF THERMAL NEUTRON ABSORPTION CROSS-SECTION IN BORON USING SPHERICAL TRANSMISSION METHOD. Gurbax Singh and A. K. Ghatak (Delhi Univ.). Proc. Natl. Inst. Sci. India. Pt. A, 27: 216-22(May 26, 1961). (In English)

The thermal neutron absorption cross-section of boron was determined to be 759 ± 11 barns by using a spherical transmission method and measuring the attenuation in the thermal neutron flux in boric acid solutions. Effect of multiple scattering of the neutrons in the absorber itself was taken into account. The effective neutron temperature is discussed. (auth)

6023 THE RADIATIVE CAPTURE CROSS SECTION OF ^{236}U FOR NEUTRONS IN THE ENERGY RANGE 0.3 TO 4.0 MEV. J. F. Barry, J. L. Bunce, and J. L. Perkin (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 78: 801-7 (Nov. 15, 1961).

The cross section of the reaction $U^{236}(n,\gamma)U^{237}$ was measured for neutrons in the energy range 0.3 to 4.0 Mev using an activation method. Fission products in the irradiated samples were removed chemically and the U^{237} produced was determined by counting the gamma activity with a sodium iodide scintillation spectrometer. The cross section was found to increase from about 300 mb at 0.3 to about 400 mb at 1.1 Mev. It then fell sharply to some 30 mb at 4 Mev. The shape of the excitation function is typical of that found for other heavy even-even nuclides far from a closed shell. This is due to the competition between radiative capture and inelastic scattering from the similar collective level structures. (auth)

6024 A NOTE ON THE CARR-PURCELL METHOD OF MEASURING NUCLEAR MAGNETIC RESONANCE RELAXATION TIMES. H. Pursey (National Physical Lab., Teddington, Middlesex, Eng.). Proc. Phys. Soc. (London), 78: 808-11(Nov. 15, 1961).

In measuring T_2 by the Carr-Purcell method the number of 180° pulses which can be used in a given sequence is limited by the accumulation of errors in pulse length, which causes a progressive departure of the freely precessing magnetic moments from the equatorial plane. Several methods are devised to overcome this limitation, but in all cases it is assumed that phase coherence exists between the precessing nuclei and the pulsing radio-frequency field. Under such conditions the errors will accumulate linearly in the orthodox Carr-Purcell experiment, but in fact the order of stability implied in the assumption is unlikely to exist unless special care is taken to obtain it. It is found experimentally, however, that good Carr-Purcell trains can be obtained in an incoherent system and the reasons for this are analyzed. It is shown that in such a system the errors add as if they were coplanar vectors of random direction, so that the statistical rms value of the error after n pulses is proportional to $\sqrt{n}$. Hence, one would expect to obtain a satisfactory train with up to 10^4 pulses, and it is shown that this is in agreement with observations. (auth)

6025 DETERMINATION OF THE FIERZ INTERFERENCE TERM FROM THE K-CAPTURE/β^+ RATIO FOR THE PURE GAMOW-TELLER DECAY OF ^{58}Co. B. R. Joshi and G. M. Lewis (Glasgow Univ.). Proc. Phys. Soc. (London), 78: 1056-63(Nov. 15, 1961).

A direct determination was made of the Fierz interference term b for the pure Gamow-Teller decay of Co^{58}. The K/β^+ ratio was determined by an internal source scintillation counter coincidence method. The value obtained was 4.92 ± 0.09. This may be compared with the recent predicted value of 4.87. Allowing for the variation in the theoretical value arising from β^+ end point uncertainty this yields a value for b of (+0.6 ± 2.3)%. Two interpretations of the result are possible on the basis of two-component neutrino theory. If, as is customarily assumed, $C_A = C_{A'}$, $C_T = -C_{T'}$, then b should vanish identically; and the small experimental value for b confirms the theory. If alternatively, $C_A = C_{A'}$, $C_T = +C_{T'}$, then the experimental result requires that C_T, $C_{T'}$ be very small. (auth)

6026 THE LIFETIME OF THE 673 kev LEVEL IN ^{132}Xe. W. D. Hamilton (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 78: 1064-70(Nov. 15, 1961).

The resonant scattering cross section for the 673 kev electric quadrupole transition in Xe^{132} was directly determined for a particular arrangement of source, scatterer, and detector. The resonant scattering condition was provided by the persistence of nuclear recoil following a preceding transition when the source was in the gaseous phase. The differential cross section for a mean scattering angle of 149° was evaluated as $\sigma(149^\circ) = 1.75 \times 10^{-28}\ cm^2\ sterad^{-1}$, and the value $\tau = (9.7 \pm 3.0) \times 10^{-12}$ sec was found for the mean-life of the level. This result is in good agreement with that obtained from a Coulomb excitation measurement. The enhancement of the E2 transition probability when represented by the ratio $B(E2; 0 \rightarrow 2)/B(E2)_{S.P.}$, has the value 20; this is consistent with the results for even-even nuclei which have characteristic vibrational spectra. (auth)

6027 THE LIFETIME OF THE 638 Kev LEVEL IN ^{131}Xe. W. D. Hamilton (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 78: 1071-3(Nov. 15, 1961).

A nuclear resonant scattering method was used to estimate the mean-life of the 638 kev level in xenon-131. The result of 4×10^{-13} sec, when compared with the Weisskopf estimate, is consistent with an enhanced E2 transition or a retarded M1 transition. However, in reported Coulomb excitation experiments there is no evidence for an E2 transition probability consistent with the present mean-life, and it is suggested that the transition may be predominantly M1. (auth)

6028 ISOTOPE SHIFT AND HYPERFINE STRUCTURE IN THE SPECTRUM OF TELLURIUM. H. G. Kuhn and R. Turner (Clarendon Lab., Oxford). Proc. Roy. Soc. (London), A265: 39-45(Dec. 19, 1961).

With the use of enriched samples of the stable isotopes of tellurium, the isotope shifts in the spark line 4049 Å were studied. Fabry–Perot fringes due to this line were measured against a mercury reference line; also the hyperfine structures of the odd isotopes were measured. The shifts in the even isotopes are compared with those in adjacent elements and discussed in terms of nuclear deformation. The odd-even staggering was found to be extremely large in tellurium. The ratio of the widths of the hyperfine structures of the isotopes 123 and 125 agrees, within the experimental limits of error of about 1% with the ratio of the nuclear magnetic moments. (auth)

6029 FEW-NUCLEON REACTIONS WITH CENTRAL FORCES. William Laskar (Univ. of California, Berkeley). Rev. mex. fis., 10: 195-218(1961). (In English)

The three-channel reactions for D(A,Z), with $A \leq 4$, have been formulated using the resonating group method. The potential used is a two-body central interaction with exchange dependence and Gaussian shape. The wave functions for the ground state of the nuclei are also Gaussian (double Gaussian for deuterons and single Gaussian for the other nuclei), the parameters being determined by a variational method to fit the binding energies. Coupled integro-differential equations have been derived for each value of the total spin and angular momentum of the corresponding system. General formulas are given for the different terms of these equations. (auth)

6030 SOME REGULARITIES IN THE ELASTIC SCATTERING OF MEDIUM-ENERGY ELECTRONS. A. N. Pilyankevich (Inst. of Powder Metallurgy and Special Alloys, Academy of Sciences, Ukrainian SSR). Soviet Phys.-Cryst., 6: 272-6(Nov.-Dec. 1961).

Using approximate Slater wave functions, a study is made of the dependence of certain characteristics in the elastic scattering of medium-energy electrons on the atomic number of the scattering atom. Periodicity is established in the change in these characteristics. (auth)

Particle Accelerators

6031 (DESY-A2.82) STRONG FOCUSSING SYNCHROTRON MAGNET WITH TILTED FOCUSSING PLANES. K. G. Steffen (Deutsches Elektronen-Synchrotron, Hamburg). Aug. 14, 1961. 9p.

A strong focussing synchrotron magnet design is considered in which the two focussing planes are tilted by 45° with respect to the conventional orientation. When used in a FODO-electron synchrotron, this magnet type would eliminate classical radiation anti-damping of betatron oscillations. Some advantages and disadvantages of the magnet are discussed. A magnet of this type may also be used as a strong focussing pair spectrometer. (auth)

6032 (JINR-P-769) O FAZIRUYUSHCHEM DEISTVII USKORYAYUSHCHEGO ELEKTRICHESKOGO POLYA V TSIKLOTRONE. (The Phase Action of an Accelerated Electrical Field in a Cyclotron). I. M. Matora (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1961. 10p.

Formulas are given which take into account the effect of the electric field component normal to the trajectories on the phase shifts of the ions accelerated in the cyclotron. The region is specified for the applicability of the general solution of the horizontal motion equations. It is shown that at the center of the cyclotron it is possible to turn the direction of the ion extraction from the source; the action is accompanied by an increase in the positive phases of the lens acceleration regime. (auth)

6033 (JINR-P-783) IZMERENIE INTENSIVNOSTI VNUTRENNEGO PUCHKA SINKHROFAZOTRONA S POMOSHCH'YU REAKTSII $C^{12}(p,pn)C^{11}$. (Measuring the Intensity of the Interval Beam of a Synchrophasotron with the Aid of the $C^{12}(p,pn)C^{11}$ Reaction). I. B. Issinskii and K. P. Myznikov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 10p.

A method is described for measuring the intensity of the internal proton beam in the accelerator by activating the carbon target and measuring the induced activity. The counter and its scheme are described. Errors in measurements are estimated. Some applications of the method to the 10-Bev synchrophasotron are indicated. (auth)

6034 (JINR-P-787) ISSLEDOVANIE KHARAKTERISTIK PUCHKA PROTONOV, USKORENNYKH V SINKHROFAZOTRONE NA 10 BEV. (Characteristics of Proton Beams Accelerated in Synchrophasotrons at 10 Bev). A. V. Kuznetsov and K. P. Myznikov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 13p.

The results of an investigation of the characteristics of the beam accelerated up to a final energy in the 10-Bev synchrophasotron are reported. The methods of investigation are described. The following characteristics were determined: the filling of the phase stability region, the distribution in betatron oscillation amplitudes, and the magnitude of the energy spread of particles in an accelerated beam. (auth)

6035 (JINR-P-808) OPREDELENIE PROFILYA POLYUSOV ELEKTROMAGNITA USKORITELYA METODOM EKVIPOTENTSIALEI S UCHETOM KRAEVOGO EFFEKTA. (Determination of Profiled Poles of Accelerator Electromagnet Considering the Edge Pole Effect). L. A. Sarkisyan (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 12p.

The problem of forming the given law of the magnetic field intensity $H_z(r, O, \phi)$ in the median plane of the accelerator with the aid of the profiled poles calculated by using the equipotential method taking into account the edge pole effect was considered. The formulas are given for calculating the complex profiles of the electromagnetic poles in the accelerators. (auth)

6036 (NYO-9683) BROAD RANGE SPECTROGRAPH FOR USE WITH THE ROCHESTER 27″ CYCLOTRON.

W. Parker Alford, O. M. Bilaniuk, and R. A. Hawrylak (Rochester, N. Y. Univ.). [1961]. Contract [AT(30-1)-875]. 24p.

A broad range nuclear spectrograph of the Buechner-Bainbridge type, with characteristic radius R = 50 cm was constructed and installed for use in conjunction with the Rochester 27 in. variable energy cyclotron. For a given magnetic field, particles are focused over an energy range $0.6E_0 \le E \le 1.3E_0$, where E_0 is the energy of particles focussed with orbit radius Q = R = 50 cm. The resolution of the spectrograph $\Delta E/E$ is less than 0.2%. Particles may be recorded either in nuclear emulsions or in an array of solid state counters. Results of calibration measurements and typical nuclear data taken with the spectrograph are presented. (auth)

6037 DESIGN AND PERFORMANCE CHARACTERISTICS OF AN X-RAY TARGET FOR ELECTRON ACCELERATORS. T. J. Hardwick and W. S. Guentner (Gulf Research and Development Co., Pittsburgh). Intern. J. Appl. Radiation and Isotopes, 12: 20-6(Nov. 1961). (In English)

A simple inexpensive and convenient x-ray target was developed for use with commercial electron accelerators. Measurements made at 3.0 Mev with an unscanned electron beam indicate a flux equivalent to 1.04 kr/min per ma of beam current at one meter from the target. The maximum practical rate of energy absorption for small samples under the above conditions is about 20 Mrad/hr, using a 5 in. scan. (auth)

6038 THE CONSTRUCTION AND TEST OPERATION OF INS-LINEAR ELECTRON ACCELERATOR. Jirō Tanaka (Tokyo Univ.). J. Phys. Soc. Japan, 16: 2081-90 (Nov. 1961). (In English)

The 6-Mev linear accelerator to be used for the injector of the 1-Bev electron synchrotron is discussed, and the construction and early tests of the accelerator including the fabrication and the assembly of the components (accelerator guide, waveguide system, electron gun and vacuum system, etc.) are described. The accelerator guide was carefully fabricated so as to match the designed structure reported previously. An rf–driven prebuncher was provided to obtain a narrow energy spread and high trapping efficiency. The results obtained by the preliminary tests indicated an energy spread of about 3% at 6.6 Mev, whereas the spread increased up to 5 to 6% without the prebuncher. (auth)

6039 THE MICROTRON. A. P. Grinberg. Uspekhi Fiz. Nauk, 75: 421-58(Nov. 1961). (In Russian)

A review is given of theoretical and experimental data on microtron operation. Technical parameters of all known microtrons are described, and their efficiency and advantages are compared with other electron accelerators. The conditions of resonance electron acceleration, electron injection, electron focusing, and the construction of microtrons are described in detail. 63 references are included. (R.V.J.)

6040 STUDY OF THE MAGNETIC FIELD CHARACTERISTICS OF A STRONG-FOCUSING SPIRAL-SECTOR ACCELERATOR. N. N. Volodichev, V. K. Grishin, S. Kovalskii, Yu. N. Lobanov, and I. A. Savenko (Moscow State Univ.). Zhur. Tekh. Fiz., 31: 1350-7(Nov. 1961). (In Russian)

Experimental studies are made of the field distribution in a strong-focusing, periodic, magnetic spiral section system. Functions expressing the radial and azimuthal distributions for radii from 50 to 58 cm are found, and correction methods are developed. (R.V.J.)

Plasma Physics and Thermonuclear Processes

6041 (JÜL-17-PP) INVESTIGATIONS ON A PULSED ELECTRODELESS RING DISCHARGE WITH MAGNETIC BIAS FIELDS OF DIFFERENT AMPLITUDES. P. Bogen and E. Hintz (Kernforschungsanlage, Jülich, Germany). Aug. 1961. 16p.

Presented at the Fifth International Conference on Ionization Phenomena in Gases, Munich, 1961.

The formation of plasma in electrodeless ring discharges with steady magnetic bias field of various amplitudes was investigated. Magnetic fields of suitable intensities were measured and the temporal behavior of the discharge was observed. It was found possible to measure the electron temperature and estimate electron density. Results show that electron temperatures depend on initial magnetic fields. (J.R.D.)

6042 (JÜL-18-PP) DENSITY DISTRIBUTIONS FROM RADIATION MEASUREMENTS DURING THE FAST MAGNETIC COMPRESSION OF A PLASMA. P. Bogen and E. Hintz (Kernforschungsanlage, Jülich, Germany). Aug. 1961. 20p.

Presented at the Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, 1961.

For determination of the compression ratio and end losses in fast magnetic compression of deuterium plasma, the radial density distribution must be known as a function of time. It is noted that this information can be obtained partly from smear camera pictures, the film density of which must be transformed to light intensity. Interpretation of intensity distribution requires information on the composition of plasma radiation and on the dependence of the intensity on plasma density and temperature. A discussion of theory and methods for determining densities from intensity measurements is included. (J.R.D.)

6043 (JÜL-19-PP) PRODUCTION OF A HIGHLY IONIZED PLASMA WITH LOW IMPURITY LEVEL, WITH AND WITHOUT MAGNETIC BIAS FIELDS FOR MAGNETIC COMPRESSION EXPERIMENTS. H. Beerwald, P. Bogen, T. El-Khalafawy, H. Fay, E. Hintz, and H. Kever (Kernforschungsanlage. Institut für Plasmaphysik, Jülich, Germany). Aug. 1961. 21p.

Paper presented at the Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, 1961.

Experiments with a preheating discharge for the production of an initial plasma with known and reproducible properties were carried out. An electrodeless ring discharge was chosen in order to make a high degree of purity of the plasma possible. Preliminary results concerning the breakdown of the gas, the formation of a highly ionized plasma, and the subsequent decay of the plasma due to end losses and recombination are reported. It was concluded that a good preionization of the gas, resulting in a high initial electron density and plasma frequency is essential for the fast growth of ionization. Both streak camera and magnetic field measurements indicated that the plasma is fairly uniformly distributed after about 5 μsec. It was found that end losses are influenced by the presence of an internal field. A compilation of measured maximum electron temperatures is presented. (M.C.G.)

6044 (JÜL-22-PP) MEASUREMENTS OF ION ENERGY DISTRIBUTION ON A PLASMA GUN. W. Bieger, D. Dorn, P. Noll, and H. Tuczek (Kernforschungsanlage. Institut für Plasmaphysik, Jülich, Germany). Oct. 1961. 15p.

Presented at the Fifth International Conference on Ionisation Phenomena in Gases, Munich, 1961.

Time resolved energy distributions of ions of the plasma ejected by a hydromagnetic gun were measured by a retarding potential spectrometer. Three pulses corresponding to different periods of origin were observed and analyzed. The longitudinal energy of the ions was in the range from 200 ev to about 1 kev, the ion temperature being of the order of 1 ev. The influence of diaphragms and the retarding field on the plasma was studied. (auth)

6045 (LAMS-2633) STABILITY OF HIGH-SPEED PLASMA STREAM. B. R. Suydam (Los Alamos Scientific Lab., N. Mex.). July 1961. Contract W-7405-Eng-36. 24p.

The stability of a plasma streaming along the lines of a magnetic field is considered. The flow is assumed to be at high speed in the sense that the kinetic energy density dominates both the thermal and the magnetic field energy densities. It is found that the flow is stable if the stream lines are straight, is unstable with growth speeds of the order of sound or Alfvén speed if the stream lines bend away from the axis of the stream, and is catastrophically unstable if the stream lines bend toward the axis. (auth)

6046 (NP-11164) PLASMOID ROTATION IN A THETA PINCH. G. L. Clark and R. F. Wuerker (Space Technology Labs., Inc. Research Lab., Los Angeles). Oct. 25, 1961. 11p.

Ultra-high speed photographic observations were made showing the behavior of theta pinch plasmoids formed by trapping magnetic fields in plasmas. The plasma phenomena in the pinch is analyzed and rotation of the plasmoids is shown to be a mechanism for accelerating ions caught in the plasma ring. (J.R.D.)

6047 (NYO-9762) PROPAGATION OF LONG WAVELENGTH DISTURBANCES IN A PLASMA. Richard L. Liboff (New York Univ., New York. Inst. of Mathematical Sciences). Oct. 2, 1961. Contract AT(30-1)-1480. 141p. (MF-22)

The long wavelength modes of excitation of a two component plasma in a steady magnetic field were examined. Two linearized Boltzmann equations are given with collision terms which are coupled through the difference in temperatures and difference in velocities of the two gases. A formal means of classification of phenomena is described in terms of the nature of the roots about $k = 0$. Two types of behavior were uncovered: MHD, magnetohydrodynamics, which includes finite phase speed phenomena near $k = 0$; and PEM, plasma electromagnetics, which includes infinite phase speed phenomena near $k = 0$. The dissipative effects of collisions were included. In the limit of vanishing collision frequency, roots previously obtained were recaptured. The relevance of the pertinent domains are discussed and the complex interplay between the "fast" and "Alfven" modes of MHD and the plasma-magnetic modes of PEM are demonstrated. Equations macroscopic in appearance were derived which include the effects of the initial configuration. In the limit of large collision frequency these equations reduced to standard forms. The dispersion of the N^{th} order Larmor resonance is given which includes the effect of the mass ratio. A discussion of the transfer equations of a plasma is included. (auth)

6048 (TID-14082) MAGNETIC FIELD REVERSAL IN A COLLISIONLESS PLASMA. George Schmidt (Stevens Inst. of Tech., Hoboken, N. J.). June-July 1961. Contracts AT(30-1)-2813 and DA-36-039-SC-87242. 20p. (SIT P41 (8-61)).

The motion of particles in collisionless plasma under field reversal is described. The possible qualitative properties of self-consistent solutions were considered. Particle motion with the effective potential, conservation of flux, and field reversal are discussed. (M.C.G.)

6049 (TID-14306) THE EXPLODING WIRE AS FAST DYNAMIC PINCH. Final Technical Report, July 31, 1961. J. Katzenstein and M. Sydor (New Mexico. Univ., Albuquerque). Contract AT(11-1)-983. 26p.

The high-current electric discharge through fine wires was studied under experimental conditions in which the interaction of the discharge with its self-magnetic field was dominant. When the wire was composed of an element or elements of low atomic number, the discharge was found to have many of the characteristics of pinch discharges in gases. A capacitor bank of 1.75 microfarads and voltage rating of 100 kv was used with a switching spark gap and circuit of very low parasitic inductance. The parasitic inductance of the condensers and circuit was measured to be 0.05 microhenry while the ringing frequency of the discharge was 370 kc. Wires of copper, aluminum, polyethylene, lithium, and lithium–lithium hydride were exploded. The discharge was photographed with streak and framing cameras and oscillograms taken of the discharge current and its time rate of change. Wires composed of lithium–lithium deuteride were observed to give neutron yields of the order of 10^6 per shot. The neutron yields were measured with a silver-foil activation counter. (auth)

6050 MINIMUM ARC DISCHARGE POTENTIALS AND THE TWO FORMS OF AN ARC WITH A COLD CATHODE. I. G. Kesaev (Lenin All-Union Electrotechnical Inst., USSR). Doklady Akad. Nauk S.S.S.R., 140: 1289-92(Oct. 21, 1961). (In Russian)

The arc discharge potentials for a stationary discharge were determined for a minimum distance between the electrodes for metals of groups I, II and III. Low values of the minimum arc potential V_a with respect to the ionization potential of the metal V_i were found for group II metals such as Zd, Cd and Hg (values of V_a/V_i vary from 0.7 for Hg to 1.22 for Cd). For group I metals (Cu, Ag, Au and Be) and group III metals (Al, Ga, In, and Tl) the ratio of the minimum arc potential V_a to the ionization potential of the metal V_i varies from 1.7 to 3.0. The arc discharge was more stable in air than in vacuum, but the deviation in the value of V_a/V_i as measured in air and vacuum did not exceed 20% as a rule. This difference in behavior can be explained by the difference in the atomic energy states of group II elements as compared to group I and III elements. Thus, the presence of metastable levels in group II metals favors the stepwise ionization of these metals by electrons. (TTT)

6051 SOME CHARACTERISTICS OF A TOROIDAL PINCH WITH A REVERSED FIELD. S. Berglund and S. Svennerstedt (Univ. of Uppsala). Nuclear Instr. & Methods, 13: 201-5(Sept. 1961). (In English)

A description is given of an experimental set up for large toroidal pinch. The primary system creates in the following order: a weak quasi-stationary axial field, the main gas current, and a strong pulsed axial field in opposite direction to the weak one. The plasma fields and associated motions are studied by magnetic probes, and the ionization stages of various elements in the discharge by optical spectroscopy. Results on the stability and the general behavior of different discharge types are given. (auth)

6052 CONVECTION OF POSITIVE PLASMA IN MAGNETIC FIELD. B. B. Kadomtsev. Zhur. Tekh. Fiz., 31: 1273-83(Nov. 1961). (In Russian)

The problems of turbulent convection of a positive plasma cylinder in the presence of a strong longitudinal magnetic field are analyzed. (tr-auth)

6053 ON THE CALCULATION OF THE STELLARATOR MAGNETIC FIELD. V. F. Aleksin (Khar'kov Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 31: 1284-8(Nov. 1961). (In Russian)

The Bio-Savar equations were used for deriving formulas for calculating helical magnetic field components and magnetic surface parameters. (R.V.J.)

6054 EXPERIMENTAL DEFINITION OF THE MAGNETIC SURFACES ENCLOSED BY SEPARATA. B. P. Il'enko and V. G. Zykov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 1289-93(Nov. 1961). (In Russian)

An attempt was made to experimentally determine the region enclosed by separata in relation to the longitudinal magnetic field and the current in a stellarator winding. In the model used, an electron beam reacts as plasma. The obtained data and calculations are correlated. (R.V.J.)

6055 NON-LINEAR OSCILLATIONS OF TWO-COMPONENT PLASMA IN MAGNETIC FIELD. Ts. D. Loladze and N. L. Tsintsadze (Inst. of Physics, Academy of Sciences, Georgian SSR). Zhur. Tekh. Fiz., 31: 1298-1301(Nov. 1961). (In Russian)

Nonlinear oscillations of two-component plasma in a magnetic field perpendicular to the wave propagation are studied without considering the plasma pressure (the plasma pressure is assumed to be smaller than the magnetic pressure $p \ll H^2/8\pi$). The nonlinear wave rate and the single pulse width are determined. (tr-auth)

6056 PLASMA MEASURING IN MAGNETIC FIELD. L. V. Dubovoi and A. G. Ponomarenko. Zhur. Tekh. Fiz., 31: 1302-8(Nov. 1961). (In Russian)

The feasibility of measuring plasma parameters by electromagnetic wave absorption in the electron cyclotron resonance region is discussed. The magnitudes of plasma density and frequencies of electron interactions with neutrals in hydrogen and argon are found as functions of electron field pressure and intensity in electrodeless discharge, and the electron temperature was measured. The derived data are correlated with probe measurements. (tr-auth)

6057 ON THE BEHAVIOR OF THE HIGH PRESSURE ELECTRICAL ARC. V. V. Yankov (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 31: 1324-8(Nov. 1961). (In Russian)

The behavior of arc discharge under forces produced by energy losses due to thermal conductivity is studied within the limits of Elenbass thermal arc discharge contraction. It is indicated that the above forces lead to a larger increase of pressure than the pinch effect. (tr-auth)

6058 HIGH ENERGY GASEOUS DISCHARGE DEVICES. Australian Patent 225,822. Sept. 10, 1958.

A high-energy electrical discharge device is described comprising an envelope, a pair of main discharge electrodes supported in opposition in the envelope, a metallic shell symmetrically disposed around and spaced from the discharge path between the electrodes, the metallic shell comprising a first element of spaced helical turns of metallic material and a second element of spaced helical turns of metallic material insulatedly supported in superposition outside in first element and with the turns overlapping the gap between the turn of the first element.

6059 HIGH ENERGY GASEOUS PLASMA CONTAINMENT DEVICE. Australian Patent 226,761. Sept. 10, 1958.

An apparatus is designed for producing neutrons as a result of collisions between ions in high-temperature plasmas. In the apparatus, the magnetic and electric fields are made to cross at substantially right angles in several places along a torus shaped containment vessel. A plasma of deuterium gas is generated in the vessel under the electric fields and is "trapped" in any one of the "crossed field" regions to produce a release of energy.

6060 THERMONUCLEAR REACTOR. Australian Patent 226,812. June 4, 1958.

A thermonuclear apparatus is described wherein a disk-shaped plasma is formed between a central electrode and a coaxial outer electrode. A transverse magnetic field through the current-carrying plasma causes rapid rotation and consequent heating thereof.

6061 THERMONUCLEAR REACTOR & PROCESS. Australian Patent 231,333. May 27, 1958.

A method for conducting a thermonuclear reaction comprises establishing a magnetic containment zone in an evacuated special region, the dimensions of such containment zone being defined by an axially symmetric magnetic field having gradiently intensified magnetic reflector regions spaced along the axis and serving as terminal closures of the said zone, and introducing and accumulating energetic fuel ions in such zone to form a contained plasma with a density sufficient to provide an appreciable thermonuclear fusion reaction rate.

6062 METHOD AND DEVICE FOR CAPTURING IONS IN A MAGNETIC FIELD. (to U. S. Atomic Energy Commission). French Patent 1,222,604. Jan. 25, 1960.

Molecular ions are injected into a magnetic field and dissociated and ionized to atomic ions and neutral particles in an arc discharge of high intensity parallel to the magnetic lines of force, after which the atomic ions are captured in the magnetic field. (NPO)

6063 NUCLEAR FUSION REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,227,775. Mar. 7, 1960.

An apparatus for heating a gas to a very high temperature comprises a toroidal tube of low electrical conductivity material with an envelope of high conductivity material having a fissure along a large circle on the toroidal tube. In the toroidal tube, a circular gas discharge can be maintained. If a large electric current pulse is passed through the envelope in the direction of a small circle on the toroidal tube the gas is heated by rapid, thermodynamically irreversible compression. (NPO)

6064 INTENSE ENERGETIC GAS DISCHARGE. (to U. S. Atomic Energy Commission). French Patent 1,229,393. Mar. 21, 1960.

A linear or toroidal energetic gas arc discharge is set up between one or more hollow cathodes and an anode which can likewise be hollow. To initiate the arc discharge, the rate of gas flow into the interior of the cathode is regulated in such a way that the arc discharge is caused to emanate from the inner surface of the cathode with the result that adequate space-charge neutralization is provided inside the cathode but not in the main arc volume. The arc discharge can be used in thermonuclear devices as a dissociating means or a portion of it can be pinched off and compressed by magnetic mirror coils to heat itself to fusion temperatures. (NPO)

6065 APPARATUS TO INJECT PLASMA INTO A THERMONUCLEAR REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,230,661. Apr. 4, 1960.

In an evacuated space, a radially inhomogeneous, axially symmetrical magnetic field having axially spaced intensified reflector field regions is increased with time; during this time, electrically charged particles are introduced at a plane perpendicular to the axis between said reflector field regions. During this time interval, the plasma is heated non-adiabatically. The energy can be increased further in an adiabatic way in the same space by increasing the magnetic field and making it radially homogeneous or by injecting the plasma into an adjacent containment field of the pyrotron type. (NPO)

6066 IMPROVEMENT OF THE PYROTRON. (to U. S. Atomic Energy Commission). French Patent 1,230,672. Apr. 4, 1960.

The reflection of moving charged particles at the magnetic mirrors of a pyrotron-type device is much improved by exciting the particles with an alternating electric field applied perpendicular to the axis of the magnetic field of the pyrotron. Preferably, the frequency of the alternating electric field corresponds to the gyromagnetic frequency of the particles. The velocity of the particles in a plane perpendicular to the axis is thus increased. (NPO)

6067 METHOD OF PRODUCING ATOMIC ENERGY BY MEANS OF A CATALYST. Jacques Weiss. French Patent 1,233,073. May 2, 1960.

The fusion reaction of four hydrogen atoms to one helium atom should be promoted by atoms of the valence 4 as a catalyst, preferably carbon which is supplied as methane. X rays should still further aid the reaction. (NPO)

6068 THERMONUCLEAR REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,233,894. May 9, 1960.

Two improvements to the Stellarator are described: (1) The helical magnetic surface is changed into a cylindrical magnetic surface at the place of the divertor and the magnetic pumping section by means of current loops at the ends of the current windings that produce the helical magnetic surface. The curved parts of the endless tube are composed of a plurality of sections having alternately positive and negative curvature. (NPO)

6069 FUSION REACTOR WITH AN ANNULAR PINCHED DISCHARGE. (to Brown, Boveri & Cie A. G. & A. G. für Unternehmungen der Eisen- und Stahlindustrie). French Patent 1,242,196. Dec. 9, 1959.

In a toroidal pinched gas discharge, the required energy is supplied by inductive accumulation of energy in primary windings on the torus, the gas discharge being the secondary. This can be done by interruption of a d-c voltage on those primary windings, e.g., through the intermediary of an auxiliary transformer. (NPO)

6070 METHOD AND APPARATUS FOR OBTAINING CONTROLLED FUSION OF ATOMIC NUCLEI. R. Nowak. French Patent 1,243,242. Aug. 29, 1960.

Controlled nuclear fusion should be brought about by collision of two beams of electrically accelerated reactive particles moving in opposite directions, each of the beams having just been exposed to homogeneous magnetic fields, respectively, parallel to and against the directions of the beams. (NPO)

6071 IMPROVEMENTS TO GENERATORS OF THERMONUCLEAR FUSION ENERGY. B. P. Lehnert. French Patent 1,257,022. Feb. 20, 1961.

A plasma is confined by the resultant of the magnetic field set up by the current in an annular electric conductor and a magnetic field substantially parallel to the annular conductor. The intensity of the magnetic field can be regulated to make possible the injection of ions tangential to the lines of force of the annular current. (NPO)

Shielding

6072 (ANL-6443) A SUMMARY OF SHIELDING CONSTANTS FOR CONCRETE. R. L. Walker (Michigan Coll. of Mining and Tech., Houghton) and M. Grotenhuis (International Inst. of Nuclear Science and Engineering, Argonne, Ill.). Nov. 1961. Contract W-31-109-Eng-38. 77p.

The present knowledge of the shielding constants of concrete is summarized. The densities, elemental compositions, and mixes, where available, are given for a wide range of concretes. From these data, various constants useful for shielding calculations were computed. These constants include the removal cross sections, total cross sections, average thermal neutron absorption cross sections, thermal neutron diffusion coefficients, reciprocal thermal neutron diffusion lengths, total gamma-ray linear attenuation coefficients, gamma-ray energy absorption linear attenuation coefficients, the effective atomic numbers for the determination of buildup factors, and the capture gamma-ray spectra. Experimental results are included where available. (auth)

6073 (DC 55-11-127) METHOD OF THERMAL STRESS ANALYSIS OF REACTOR SHIELD ASSEMBLIES. H. A. Eagle, R. J. Kroll, C. M. Roscher, and A. L. Ross (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 25, 1955. Decl. July 10, 1961. Contract AT(11-1)-171. 90p.

The last in a series of reports published to meet Task 7710 Milestone No. II; "Produce Report on Thermal Stresses in a Solid Moderator Reactor Shield" is presented. The method of solution is applicable for rotationally symmetric temperature gradients and applies to thin-walled structures. The previous reports in which methods of analysis for certain components whose solution was not available were written by Dunholter, Kroll, and Roscher, and are listed in the bibliography. A summary of these reports, and other methods published in the literature is presented which is combined in a form applicable to the analysis of composite structures such as the Reactor Shield Assembly. A thermal stress analysis in which stresses arising from temperature gradients within each separate component is presented along with a consideration of the stresses arising from the enforcement of continuity conditions at the edges of adjacent components, which except for their mutual constraint would expand thermally at different rates. (auth)

6074 (DC-57-7-51) GAMMA RAY AND FAST NEUTRON ATTENUATION IN YH_x AND ZrH_x. L. K. Zoller (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 8, 1957. Decl. June 1, 1961. Contract AT(11-1)-171. 19p.

Using a one-watt point isotropic source, geometry independent curves of gamma ray and fast neutron attenuation are plotted as function of material thickness in grams per square centimeter, for hydrided yttrium and hydrided zirconium at hydrogen concentrations of 3×10^{22}, 4×10^{22}, and 6×10^{22} nuclei per cubic centimeter. (auth)

6075 (USNRDL-TR-533) GAMMA-RAY PENETRATION EXPERIMENTS FOR A LIGHT AIRCRAFT CARRIER USING DISTANT SOURCES AND SOURCES SIMULATING CONTAMINATION OF THE HULL. S. Tomoeda, M. B. Hastings, and W. G. Miller (Naval Radiological Defense Lab., San Francisco). Oct. 19, 1961. 83p.

The penetration of gamma rays into compartments of an aircraft carrier from radioisotopes was measured. In one experiment, Co^{60} and Cs^{137} point isotropic sources were exposed near the hull of the ship to simulate hull contamination. Measurements of dose were made in the forward part of the ship at four different deck levels. Dose distribution data are presented for the two sources used and for the different source points considered. In the second experiment, a nominal 500-curie collimated Co^{60} source was exposed at a distance of roughly 100 feet from designated points to irradiate two general regions of the ship. Dose distributions are presented for each of 18 different source positions used. Five decks were instrumented in each of the two general regions considered. Diagrams indicating source positions, detector positions, and hullplating thicknesses are also presented. (auth)

6076 (XDC-57-1-32) FAST NEUTRON ATTENUATION IN HYDROGENOUS MATERIALS. W. E. Edwards (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 28, 1956. Decl. June 9, 1961. 15p. Contract [AT(11-1)-171].

Curves of fast neutron dose rate as a function of material thickness in gm/cm^2 are presented for several hydrogenous materials recently considered for shielding. The curves are geometry independent and are based on one watt point isotropic U^{235} fission sources. (auth)

6077 GAMMA RAY STREAMING THROUGH TWO-LEGGED RECTANGULAR DUCTS. J. C. LeDoux and A. B. Chilton (U. S. Naval Civil Engineering Lab., Port Hueneme, Calif.). Nuclear Sci. and Eng., 11: 362-8(Dec. 1961).

An analytical approach is developed to permit determination of gamma radiation attenuation in passing through two-legged rectangular ducts and shelter entranceways. The approach used employs the albedo concept for wall scattering and includes correction terms necessary to account for "corner lip" effects. With appropriate simplifying assumptions, moderately simple engineering formulas are obtained. Actual use of the formulas requires better knowledge of differential angular albedo than is available; however, by assuming isotropic distribution of the albedo function, a good comparison of experimental information with calculated results is obtained. (auth)

6078 ADDITIONAL EXPONENTIAL REPRESENTATIONS OF GAMMA-RAY BUILD-UP FACTORS. G. L. Strobel (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 11: 450-1(Dec. 1961). (WAPD-T-1306)

A three-parameter exponential representation is used to find the γ-ray build-up factors in U, Al, Sn, Pb, and W. For each of these materials, the three parameters are given as functions of the γ energy from 0.5 to 10 Mev. The differences between results of the exponential representation and the moments method are also given; these differences are found to be greatest at penetration depths less than about 10 mfp. (T.F.H.)

6079 PASSAGE DEVICE IN A SHIELDING WALL PROTECTING AGAINST RADIATION. (to Société Générale d'Exploitations Industrielles). French Patent 1,235,347.

For passing cables or pipes through a shielding wall, the center line of a channel passing through said walls follows a helix. This channel is suitably made by providing during the molding process of the shielding wall a core that corresponds to the shape of said channel and can be sacrificed after the molding is completed. The cables or pipes through said wall are bent beforehand into the shape of the channel and are introduced by screwing. (NPO)

Theoretical Physics

6080 (ARL-TN-60-166) SURVEY OF GRAVITATIONAL RADIATION THEORY. Technical (Scientific) Note No. 10. F. A. E. Pirani (London. Univ. King's Coll.). June 27, 1960. Contract AF61(052)-48. 24p. (AD-260997).

A survey, to early 1960, of the covariant part of gravitational radiation theory is presented. Attention is given to (1) the theory of gravitational wave-fronts, (2) the algebraic and differential properties of the Riemann tensor and their implications for wave propagation, and (3) exact vacuum metrics representing gravitational waves. It is concluded that the present theory gives a good understanding of wave propagation in a wide class of somewhat idealized situations and some strong indications of the behavior of actual gravitational radiation fields. The satisfactory development of the theory awaits the discovery of exact vacuum metrics representing radiation from isolated finite systems. (auth)

6081 MOVING AND RADIATING PARTICLES IN GENERAL RELATIVITY. Jean Hély. Compt. rend., 253: 2329-31(Nov. 20, 1961). (In French)

Several general relativistic models for charged, radiating particles are introduced, under the assumption that the particle may have several types of motion (e.g., vibration and rotation). (T.F.H.)

6082 DEDUCTION OF THE EXISTENCE OF AN "INERTIAL EFFECT OF SPIN" FROM THE POSTULATES OF THE DIRAC THEORY OF THE ELECTRON. Olivier Costa de Beauregard (Institut Henri Poincaré, Paris). Compt. rend., 253: 2332-4(Nov. 20, 1961). (In French)

Several theorems in the Dirac theory are presented, concerning the probabilities of existence, the form of the impulse-energy operator, etc. These theorems are applied to a continuous medium with an intrinsic spin, in order to demonstrate the asymmetry of the physical inertial tensor found in the Dirac electron theory, and to deduce the existence of an "inertial effect" of spin. (T.F.H.)

6083 THE CLASSICAL THEORIES OF RADIATION REACTION. Thomas Erber (Illinois Inst. of Tech., Chicago). Fortschr. Physik, 9: 343-92(1961). (In English)

Classical theories of radiation reaction are critically reviewed. The renormalized Dirac theory is discussed in particular detail. It is shown that all regularization prescriptions for this theory may be derived from a general dynamical correspondence principle. It is also shown that the physical content of the theory is severely limited by a general radiation condition. Various non-local and extended electron theories are classified with the help of the Herglotz-Wildermuth "runaway" theorem. The existence of electrodynamic collective modes are discussed; in particular the radiationless and self-excited states of extended charge structures. A possible connection with the existence of the μ meson is pointed out. In the concluding section various problems raised by the phenomenological radiation reaction theory of Ginzburg and Eidman are considered. (auth)

6084 THE TOTAL ENERGY-MOMENTUM VECTOR OF A CLOSED SYSTEM IN GENERAL RELATIVITY. C. Pellegrini (C.N.E.N., Frascati, Italy). Nuovo cimento (10), 22: 427-8(Oct. 16, 1961). (In English)

Four conditions necessary for the existence of a physically meaningful energy-momentum complex θ_i^k are given. The so-called Møller energy-momentum complex T_i^k satisfies three of these conditions, but not the fourth, viz. that the total energy-momentum P_i of a closed system should be time-independent and should transform as a 4-vector under Lorentz transformation. For the special case of a closed static system, a new definition of P_i is derived, in terms of which the T_i^k satisfy all four of the required conditions. (T.F.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 5548 and 5654

6085 (ANL-6452) LECTURE NOTES ON IN-CORE INSTRUMENTATION FOR THE MEASUREMENT OF HYDRODYNAMIC PARAMETERS IN WATER-COOLED REACTORS. Glenn F. Popper (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-Eng-38. 71p.

Presented at Advanced Course on In-Core Instrumentation for Water Cooled Reactors, Netherlands-Norwegian Reactor School, Kjeller, Norway, August 21–September 1, 1961.

The development of in-core instrumentation capable of effectively measuring pressures, temperatures, flow rates, steam void fractions, steam-water interface level, and neutron and gamma fluxes within the reactor core during static, dynamic, and transient operation is discussed. The techniques and instruments developed for use in the Experimental Boiling Water Reactor are described. A brief description of the plant is given and the in-core instruments are shown positioned in the core and vessel. (M.C.G.)

6086 (APAE-Memo-296) EVALUATION OF WIRE SCANNER FOR SM-1. S. N. Kemp (Alco Products, Inc., Schenectady, N. Y.). Nov. 22, 1961. Contract AT(30-1)-2639. 64p.

Preliminary design concepts are presented for a wire scanner for experimentally evaluating spatial variations of neutron flux in the SM-1 reactor core. Results of a literature search and determination of optimum criteria for flux mapping the core in minimum time dictated requirements for design concepts and specifications. The utility of both manually instrumented and automatically instrumented wire scanners was analyzed with respect to rapidity of measurement, selectivity of detector location, cost, value of data, plant downtime, and additional factors. (auth)

6087 (APAE-Memo-297) SINGLE ELEMENT FLOW TESTS FOR TYPE 3 (SM-2) FUEL ELEMENTS IN SM-1, SM-1A, AND PM-2A CORES. P. S. Krause (Alco Products, Inc., Schenectady, N. Y.). Nov. 27, 1961. Contract AT (30-1)-2639. 85p.

Channel-to-channel flow distribution within Type 3 (SM-2) stationary and control rod fuel elements modified for use in the SM-1, SM-1A, and PM-2A core support structures and control rod tubes was measured in single element flow testing. Plots of channel-to-channel flow distribution and element pressure drop at various element flow rates are given. Flow distribution for the top-orificed SM-1A and PM-2A stationary elements was within the ±12% deviation from element average utilized in previous thermal analyses of these cores. Testing of the bottom-orificed SM-1 stationary element and the SM-1, SM-1A, and PM-2A control rod assemblies showed flow distribution exceeded ±12% deviation from average. Simple modifications to the SM-1 stationary element indicated the possibility of improving flow distribution in that element. (auth)

6088 (APEX-237) RESULTS OF NUCLEAR PARAMETER STUDY OF PENTALENE MODERATED REACTORS. R. M. Cohen (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 24, 1954. Decl. July 6, 1961. Contract [AT(11-1)-171]. 13p. (XDC-54-12-17)

A nuclear parameter survey of pentalene moderated reactors was completed. Thirty-six reactors were analyzed to determine quantitatively the optimum design region in which both the uranium investment and core diameter are reasonably low. The variables investigated were moderator volume fraction (via variable tube spacing), fuel loading, and fuel tube structural material (beryllium and 9% Cr–1% Mo stainless steel). Two different tube sizes were considered in the study, one necessitating 85 tubes, and the other a 55-tube configuration, each providing identical free flow areas for operation of two 25 : 1 compression ratio engines. Criticality data are presented as graphs of uranium investment versus pentalene volume fraction for each of the four core structures, using as a basis for comparison 6%, 8%, and 10% excess reactivity (allowance for control). (auth)

6089 (APEX-305) FEASIBILITY STUDY OF CLAD ZIRCONIUM–HYDROGEN ALLOYS AS SOLID MODERATORS. Coy L. Huffine (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 17, 1955. Decl. June 9, 1961. Contracts AF33(038)-21102 and AT (11-1)-171. 25p.

Work was conducted to demonstrate the usefulness of clad ZrH_n as solid moderator material. Specimen fabrication, stability tests, and longitudinal temperature-gradient tests are described. No loss of hydrogen from clad moderator sections was observed in 100-hour periods at temperatures below the equilibrium formation temperature of the alloy. (auth)

6090 (APEX-338) HTRE NO. 1 REACTOR AND CONTROL SYSTEM SIMULATOR. S. W. Ahrends (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 20, 1955. Decl. June 9, 1961. Contracts AF33 (038)-21102 and AT(11-1)-171. 29p.

The simulation of the HTRE No. 1 reactor and control system is described. This simulator was developed for use with a heat transfer simulator and an X39 engine simulator as an aid in defining the safe operating region and characteristics of the HTRE No. 1 power plant. (auth)

6091 (APEX-364) DUCT MOCKUP EXPERIMENTS AT THE CONVAIR GROUND TEST REACTOR. J. W. Haffner (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 1956. Decl. June 16, 1961. Contracts AF33(038)-21102 and AT(11-1)-171. 35p.

An analysis of the Convair Ground Test Reactor experiments on the simplified annular duct mockup has been carried out. The fast-neutron duct leakage was found to be estimable to within a factor of 2 for annular ducts in water. Gamma-ray duct leakage is approximately one order of magnitude less than the fast-neutron duct leakage. (auth)

6092 (APEX-377) PRODUCTION OF PEBBLE-TYPE FUEL ELEMENTS. H. C. Brassfield (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 1955. Decl. June 16, 1961. Contracts AF33(038)-21102 and AT(11-1)-171. 18p.

A capillary-drop method of producing spherical shapes of brittle materials less than 0.100 inch in diameter was developed. It appears to be a feasible means for producing large numbers of pebble-type fuel element cores. Coating of pebble-type fuel element cores by the coating-pan technique, though not adequately developed, showed promise. (auth)

6093 (APEX-474) THE RELEASE OF FISSION PRODUCTS FROM REACTOR FUEL. A Literature Survey. P. H. Wilks (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 23, 1959. Decl. June 9, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 33p.

A discussion of available data on fission product release is presented. The survey is divided into data from actual incidents, field release experiments, laboratory release from fuel element samples, and pyrometallurgy. An author index and an alpha-numerical index are included. (auth)

6094 (APEX-482) ADDENDUM TO D102A HAZARDS REPORT. C. C. Gamertsfelder, B. Blumberg, and T. W. Schoenberger (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 15, 1959. Decl. June 16, 1961. 96p. Contract [AT(11-1)-171].

Further evaluation of the assembly is presented with regard to the hazards involved in the continuation of Heat Transfer Reactor Experiment No. 3. This additional evaluation was made taking into consideration the conditions leading to the power excursion of November 18, 1958. Operation of the rebuilt core is scheduled to start in July of 1959. The reactor is essentially the same as was tested up to November 1958. The fuel is completely replaced with fuel cartridges of the same design. Most of the moderator assemblies were salvaged. However, all moderator assemblies were modified slightly to correct an interference condition. The control rod guide tubes also required partial replacement. Limitations in operating procedure are more explicitly defined. These, and the modifications in design, are described in detail. Further information concerning the probability and seriousness of reactor accidents is also included. (auth)

6095 (AROD-2319.2) THE HELICAL CONTROL ROD. Interim Technical Report No. 1 [on] STUDIES IN REACTOR OPTIMIZATION. C. R. Mac Vean (Cornell Univ., Ithaca, N. Y.). Aug. 30, 1961. 24p.

Problems connected with ordinary control rods were considered and it appears that they are essentially caused by the necessity to insert and subsequently move lengths of neutron absorber in the reactor core. The helical control rod, which utilizes the principle of changing effective radius rather than changing effective length, may be capable of alleviating some of these problems. Calculations indicate that the reactivity equivalent of the helical control rod is such that adequate control may be provided with systems of reasonable size. The construction of a segment of the helical control rod and subsequent experiments demonstrate the mechanical feasibility of such a system in that torque requirements are not excessive, and that fatigue problems may be overcome by proper hinging arrangements at absorber anchor points. A fail safe characteristic can be built into the helical control rod system by the use of external springs. In addition, control and reliability problems are simplified by the direct connection between the drive motor and control rod and the elimination of the necessity for converting rotary motion to linear motion. (auth)

6096 (BAW-1234) SPECTRAL SHIFT CONTROL REACTOR BASIC PHYSICS PROGRAM. AGE MEASUREMENTS IN $ThO_2-D_2O-H_2O$ LATTICES. D. M. Roberts and W. G. Pettus (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Dec. 1961. Contract AT(30-1)-2602. 118p.

The age of U^{235} thermal fission neutrons in mixtures of $ThO_2-D_2O-H_2O$ was determined as part of the basic physics program for the Spectral Shift Control Reactor (SSCR). The volume ratio of moderator to aluminum-clad thoria pellets was 1.00, and the square pitch was 0.548 inch. The results of these experiments confirmed the following: the size of the lattice was adequate; the void behind the source produced insignificant perturbation; within the experimental uncertainty, there was no anisotropy in relation to the orientation of the pin axis with the detector axis; measurements in the moderator gave the same results as measurements in the thoria; and measurements were sensitive to the material used to hold and position the detectors. The measured ages in the $ThO_2-D_2O-H_2O$ lattice are given for various moderator concentrations. There was some indication that a correction for absorptions in indium at energies other than 1.46 ev tends to raise the ages by about 4% at low D_2O concentrations and by 9% at high concentrations. (auth)

6097 (BMI-X-177) FISSION-PRODUCT RELEASE FROM FUEL-ELEMENT CLADDINGS. Quarterly Progress Report, July—September 1961. Arthur A. Bauer (Battelle Memorial Inst., Columbus, Ohio). Oct. 1, 1961. Work performed under United States-Euratom Joint Research and Development Program. Contract W-7405-Eng-92. 4p. (EURAEC-190)

A program was begun to study the rate of migration through and provide data on the magnitude of release of fission products from cladding materials. Iron-base alloys were selected for initial study. Unalloyed iron and Fe—20 wt % Cr were prepared by induction melting for fabrication into tubing, sheet, and foil form. The fabrication of UO_2 pellets to load the tubing was initiated. Systems were designed for collection of fission gases evolved during electropolishing and diffusion anneal. (M.C.G.)

6098 (DC-55-10-78) REACTOR KINETIC AND TEMPERATURE EQUATIONS. J. R. Terrall (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 15, 1955. Decl. June 16, 1961. 22p. Contract [AT(11-1)-171].

The kinetic and temperature equations for a direct cycle reactor of the GE-ANP type are considered, with the goal of obtaining time-varying fuel element temperatures and the output air temperature as these quantities depend on inlet air temperature and mass flow and on control rod motion, which are assumed given as functions of time. Supplementary information provided in the course of the calculations includes the time variation of reactor power. The main assumption made is that the space-energy characteristics of the reactor flux go from one equilibrium condition to another no matter what time variations are occurring. With the results presented here, an electronic analogue computer can be used as a reactor simulator in conjunction with a real engine and reactor control system to obtain fairly realistic information on the whole reactor-engine system. An important feature of the method presented here is that fuel and air temperatures can be found anywhere in the reactor by using only the characteristics of the air entering the core, and the fissioning rate. (auth)

6099 (DCL-57-1-129) A REACTOR POWER SERVO INPUT APPLICABLE TO THE CONTROL OF ANY TYPE OF NUCLEAR REACTOR. G. E. Gorker (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 29, 1957. Decl. Sept. 8, 1961. Contract AT(11-1)-171. 12p.

An invention disclosure which reveals an electrical servo input such as required to select and maintain a given reactor power level is presented. This servo input is applicable to the control of any type of nuclear reactor and is rather unique in that it is a relatively simple way of accomplishing so many of the desirable control functions required in reactor design and operation. The servo input is also applicable to low power research reactors whose prime function is to produce neutron and gamma radiation at various energy levels. (auth)

6100 (DP-630) RESIDUAL STRESSES IN NATURAL URANIUM FUEL. J. Walter Joseph, Jr. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1961. Contract AT(07-2)-1. 16p.

The residual stresses in cylindrical fuel elements of natural uranium were determined by the Sachs boring-out method. The fuel elements that were studied had outside diameters between 1.0 and 2.4 inches and were clad with either aluminum or zirconium that was bonded to the uranium cores by several different processes. The process used to clad hollow fuel elements produced large tensile stresses at the inner surfaces of the cores. Modification of one cladding process greatly reduced the tensile stresses at the inside surfaces. (auth)

6101 (GAMD-1881) TRANSPORT OF BORON FROM HTGR IN A LOSS OF COOLANT ACCIDENT. L. R. Zumwalt (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Dec. 13, 1960. Contract AT(04-3)-314. 7p.

Studies indicated that in an accident where the hot zone temperature would reach the order of 4400°F and the average temperature 3400°F, the transportation of boron by helium undergoing convection through the core would set an upper limit for boron loss. The rate of loss of boron from the core was estimated to be 0.44 kg/day. A calculation was also made of the rate of diffusion of boron from control rod material. With 15 rods in the hot zone, an upper limit of diffusion of 1.6 kg in 24 hours was estimated. (M.C.G.)

6102 (HW-61417) OUT-OF-REACTOR TESTS ON Pu–Al TYPE PRTR ELEMENTS FOR 1706-KER TESTING. D. R. Doman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 7, 1959. Contract AT(45-1)-1350. 11p.

Two Pu–Al core fuel element designs were proposed for irradiation testing: a four-rod cluster design and a seven-rod cluster design with the same geometrical spacing as the seven center rods of the 19-rod cluster PRTR elements. Pressure drop tests were made at room temperature giving a drop of about 0.4 psi at 60 gmp for the four-rod cluster and a drop of 2.05 psi at 60 gpm for the seven-rod cluster. Corrosion and integrity tests at high temperature were made only on a Zircaloy-3 clad element of the four-rod cluster design since individual components of the seven-rod cluster design were previously tested in high temperature autoclaves or on other fuel elements. The only problem encountered was the occurrence of stringer type surface corrosion. Additional testing on another special four-rod cluster test piece showed that this could be eliminated by removing one to two mils of material from the surface with a HNO_3–HCl etch. Based on the results of the pressure drop and high temperature integrity tests, the general design of both elements appeared to be acceptable. (auth)

6103 (JÜL-10-Re) BERECHNUNG DES GAMMASTRAHLUNGSPEGELS UND DES THERMISCHEN NEUTRONENFLUSSES IN DEN DETEKTOREN DES ANFAHR- UND ABSCHALTKANALS DES REAKTORS, MERLIN. (Calculation of Gamma Radiation Level and the Thermal Neutron Flux in the Detectors of the Startup and Shutdown Channels of the MERLIN Reactors). G. Meister (Kernforschungsanlage, Jülich, Germany). June 1961. 49p.

An investigation was made of the nuclear instrumentation of the MERLIN reactor. The signals in the startup and shutdown channels for different characteristic operating conditions of the reactor were calculated. Type, position, and screening of the radiation detectors used in the two channels are described. The method of calculating the gamma radiation flux at the location of the detector is explained and the results are summarized. The gamma-signal in the shutdown channel was calculated for the critical reactor at saturation of the fission product concentration and the signal in the startup channel for a shutdown reactor depending on the shutdown period which was assumed to be of such length that the fission product concentration had attained equilibrium. The calculations of the thermal neutron flux at the position of the detector are given. The corresponding neutron signals in the shutdown channel for the critical reactor and in the startup channel for the subcritical reactor were calculated at different values of negative reactivity. The results in regard to the function of the two channels are discussed. (tr-auth)

6104 (LAMS-2647) QUARTERLY STATUS REPORT ON LAMPRE PROGRAM FOR PERIOD ENDING NOVEMBER 20, 1961. (Los Alamos Scientific Lab., N. Mex.). Dec. 1961. Contract W-7405-Eng-36. 19p.

LAMPRE I. The operations and activities carried out in conjunction with LAMPRE I are summarized. Fuel and Container Development. Corrosion testing of containers made out of various tantalum alloys is described, and data are presented on the tensile properties of high-purity Ta sheet. A ternary phase diagram is presented for molten Pu–Ce–Co alloys. Melting points are given for a number of ternary U alloys and systems. A preliminary test of 5 ceramic crucibles with Pu–U–Mn fuels was made at 900°C. Process Research and Development. A process for reprocessing UC–PuC buttons was developed which comprises the following steps: dissolution in 13 M HNO_3–0.05 M HF, dilution, extraction of Pu and U into TBP, and selective stripping of Pu and U. A volatilization-liquation run on irradiated Pu is described. A processing method was devised for recovery of U and Pu from sodium paste blankets or paste cores. Concept Development. Results of an analysis of a one-region, direct contact reactor using U–Pu fuel is given. Critical Experiments. A small-scale critical test of a circulating fuel, direct contact core called Pint Bottle Experiment is described. 2000-kw Sodium Test Facility. Its operation is described briefly. Core Test Facility. Progress on the design and development of the Facility is summarized. (D.L.C.)

6105 (NAA-SR-6646) DESIGN AND CONSTRUCTION OF THE OMRE PARTICULATE REMOVAL LOOP. H. Cataldo (Atomics International Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 30, 1961. Contract AT(11-1)-Gen-8. 48p.

The design and construction of the coolant particulate removal loop for the Organic Moderated Reactor Experiment (OMRE) is described. The design philosophy and criteria, clean-up systems selection, design of the component systems, foundation, shielding, controls and instrumentation, preheating and insulation, water and nitrogen services, electric power, loop phase subdivision, feed and return header system, and coolant cleanup systems are discussed. Preoperational activities for loop evaluation are described. (M.C.G.)

6106 (NEPA-1100) COMPARATIVE CRITICAL CONDITIONS IN SIMPLE NUCLEAR REACTORS. A. O. Mooneyham (Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn.). Aug. 1, 1949. Decl. July 18, 1961. 48p. Contract [W-33-08-ac-14801(16250)].

The physical and nuclear properties of simple critical reactors are compared. Those considered include homogeneous, gas-cooled, enriched, cylindrical, and room temperature reactors containing hydrogen, beryllium oxide, beryllium carbide, graphite, or iron. Comparisons are made of U^{235} investments, critical sizes and other parameters and their interpretations. (J.R.D.)

6107 (NEPA-1207) AN AXIAL CONTROL ROD IN CYLINDRICAL REACTORS. Theodore Rubin, Henry E. Stern, and Fritz W. Mezger (Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn.). Nov. 15, 1949. Decl. July 18, 1961. 50p. Contract [W-33-08-ac-14801 (16250)].

The effects of an axial absorber type control rod in terms of flux and power distribution and change in reactivity are examined. The effects of slug removal on reactivity is also examined. Cylindrical reactors with wide ranges of Be_2C-UC_2 molecular ratios were considered. Data on reactivity changes are included. (J.R.D.)

6108 (NEPA-1783) A STUDY OF THE URANIUM–BISMUTH ALLOY CIRCULATING FUEL REACTOR. Angus MacDonald (Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn.). Mar. 1, 1951. Decl. July 18, 1961. Contract [W-33-08-ac-14801(16250)]. 34p.

A preliminary design is presented of a water moderated Bi circulating fuel reactor. The reactor consists of 55 stainless steel tubes through which the solution of U and Bi flows. Each 3-in.-diameter tube is surrounded by a $^1/_4$-in.-thick layer of insulation and an outer tub of Al alloy. The Al alloy tubes are surrounded by water which circulates through the reactor and external cooling system. A preliminary design is included for a $Be_2C + {}^1/_3C$ moderated Bi circulating fuel reactor with $Be_2C + {}^1/_3C$ moderator rods suspended in swivel sockets in the reactor, through which flows the molten solution of U in Bi. (C.H.)

6109 (ORNL-3221) FEASIBILITY STUDIES—NONDESTRUCTIVE TESTING OF THE ENRICO FERMI REACTOR CORE B FUEL ELEMENT. R. W. McClung (Oak Ridge National Lab., Tenn.). Jan. 11, 1962. Contract W-7405-eng-26. 45p.

A series of feasibility studies which were conducted to determine the capabilities and limitations of several nondestructive testing methods as applied to the Core B fuel element of the Enrico Fermi Fast Breeder Reactor are discussed. An eddy-current technique is demonstrated to be capable of measuring the fuel plate-clad thickness with an accuracy of ±0.001 in. Discussion is presented of a through-transmission ultrasonic technique which is capable of detecting core-clad interface nonbonds which are $^1/_8$ in. in diameter or larger. A radiographic technique is described which can be used to detect UO_2 concentration inhomogeneities in excess of the specified ±5% tolerance. Description is made also of an eddy-current system which will measure coolant channel spacing between fuel plates with an accuracy of 0.0005 in. Details of each of the test systems are presented. (auth)

6110 (ORNL-TM-99) COOLING OF THE HFIR BERYLLIUM REFLECTOR FOLLOWING A REACTOR SCRAM OR AN ELECTRICAL POWER OUTAGE. H. A. McLain (Oak Ridge National Lab., Tenn.). Dec. 12, 1961. Contract [W-7405-eng-26]. 23p.

Thermal stresses in the HFIR beryllium reflector were computed for the unlikely case where the reactor is scrammed with a simultaneous loss of coolant flow and for the case following an electrical power outage where the reactor power level and the coolant flow rate are reduced simultaneously. For the case where the reactor is scrammed with a sudden loss of the coolant flow, the resulting maximum tensile thermal stress following the scram is 22,500 psi. In case of an electrical power outage, the maximum tensile thermal stress following a reduction of the fission power level from 100 Mw to 10 Mw with the lowering of the coolant flow rate to 10% of the normal value is 12,800 psi. (auth)

6111 (ORO-506) FUEL-BEARING FIBERGLAS IN ALUMINUM BASE FUEL ELEMENTS. Eighth Quarterly Report, July 1, 1961 to September 30, 1961. R. H. Baskey (Clevite Corp. Mechanical Research Div., Cleveland). Oct. 30, 1961. Contract AT-(40-1)-2557. 20p.

Fuel plates containing aluminum-coated, uranium-bearing fiberglas core sections were clad with two types of cladding material, i.e., Al clad 5154 or Al clad fiberglas-reinforced aluminum. The Al clad 5154 fuel plates indicated the most promise. They had tensile strengths of 29,100 psi at room temperature while the Al clad fiberglas-reinforced aluminum plate strength was 12,450 psi at room temperature. In addition, the Al clad 5154 fuel plates were stronger at all temperatures up to 600°F. The Al clad 5154 fuel plates cold rolled 5% could be formed on MTR dies while the cold rolled Al clad fiberglas-reinforced plates cracked at the crown during forming. Stress rupture tests of hot pressed aluminum coated, uranium-bearing fiberglas, now in progress, indicated that strengths up to 400 hours are as good as short time tensile values. (auth)

6112 (RISÖ-19) REACTOR TRAINING SIMULATOR WITH AUTOMATIC AMPLITUDE RESCALING. Jens Rasmussen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Sept. 1961. 16p.

Paper presented to the Third International Conference on Analog Computation, September 1961, Opatija, Yugoslavia.

A reactor training simulator is described in which a simple rescaling system is used to obtain a power range of many decades. The reactor power and temperatures are computed by conventional analog methods, but the integrators used in the neutron flux computer are of a new design which makes it possible to change the amplitude scale of this computer automatically by a factor of 10 and 0.1. Rescaling time is about 0.5 seconds. The sensitivities of the measuring channels are controlled by the rescaling circuit in such a way that very little disturbance due to the rescaling is seen on the traces of the recorders in the control console. In the temperature and reactivity computers, no rescaling is needed as the range of the operational amplifiers is sufficient. Circuit diagrams of the rescaling system and measuring channel records showing a "start up" and a "scram" of the reactor are included. (auth)

6113 (TID-14436) STUDIES OF REACTOR CONTAINMENT. Monthly Technical Progress Reports No. 54 and 55, October 1, 1961 through November 30, 1961. T. A. Zaker (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Dec. 8, 1961. Contract AT(11-1)-528. 6p.

Work was devoted to improvement of capabilities of the UNIVAC 1105 computer program devised for the calculation of one-dimensional wave motion in finite-depth layered shields of crushable material subjected to arbitrary time-variable surface loadings. A test series was carried out to provide complete dynamic data on balsa wood in the vicinity of the crushing strength of the material. Work was continued on extension of the approximate solution for the response of rigid-capped cylinders under static internal pressures to the case of cylinders with hemispherical heads. Solutions were obtained for the range of shell and material parameters of interest for both linear and parabolic hardening materials. (M.C.G.)

6114 (TID-14469) LITERATURE SURVEY: SAMPLING, PLATE-OUT AND CLEANING OF GAS-COOLED REACTOR EFFLUENTS. M. N. Myers (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati).

Apr. 4, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 26p. (XDC-61-4-702)

References (197) are given to patents and U.S. and foreign reports and periodicals published from 1930 to 1960. A summary of the literature on the absorption of iodine, xenon, and krypton on activated charcoal, molecular sieves, silica gel, silver, and silver compounds is included. The operation and fission product removal efficiency of a number of types of scrubbers and electrostatic precipitators are also given. (P.C.H.)

6115 (WAPD-TM-308) METALLURGICAL EXAMINATION OF FUEL ROD FROM PWR-1 BLANKET AT THE END OF THE SECOND SEED LIFE. L. R. Lynam (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Dec. 1961. Contract AT-11-1-GEN-14. 13p.

The most highly depleted PWR Core 1 blanket fuel rod was examined after an exposure of two seed lives. The rod showed no significant changes in rod dimensions, fuel microstructure, or cladding microstructure. The fission gas release was low and in agreement with experimental data obtained on irradiation tests of similar type fuel elements. The hydrogen pick-up of the Zircaloy-2 sheath was consistent with theoretically calculated values. Extrapolation of the data obtained and comparison with known experimental data show that no adverse effects are anticipated in the performance of PWR Core 1 blanket rods during Seed 3 lifetime. (auth)

6116 (XDC-55-9-158) PRELIMINARY HTRE NO. 1 PROJECT 100 OPERATION MANUAL 21, REACTOR ASSEMBLY, CORE "A." J. O. Woodbridge, ed. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 28, 1955. Decl. June 9, 1961. 211p. Contract [AT(11-1)-171].

A compilation is given of the information directly concerning operation of the Heat Transfer Reactor Experiment, Reactor Assembly Core A. An introductory discussion includes a general description of the HTRE and the Reactor Assembly Core A, power plant characteristics, and detailed descriptions of the control, instrumentation, and auxiliary systems. A discussion on operational techniques includes descriptions of checkouts, operating limits, startup procedure, period range procedure, power range procedure, shut down procedures, and safety precautions. (C.H.)

6117 (XDC-58-1-137) D 102-A FUEL ELEMENT NUCLEAR DESIGN. W. L. Orr and R. M. Cohen (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 8, 1957. Decl. June 9, 1961. Contract [AT (11-1)-171]. 30p.

The final design specifications for Project 102 fuel elements are documented. The design philosophy and the nuclear design procedures are also discussed. Nuclear performance predictions for the elements are presented in the form of fine radial heat flux distributions for various cell locations. The effects of circumferential power scalloping on heat flux distributions are shown for a number of cell locations in terms of sector distributions. (auth)

6118 CONSTRUCTION PROPOSALS FOR CHEMONUCLEAR REACTORS. W. Baur (Studiengruppe für Angewandte Radio- und Strahlenchemie, Heidelberg, Ger.). Atomkernenergie, 6: 425-33(Nov. 1961). (In German)

Chemonuclear reactors are reactors in which the radiation released with nuclear fission can be used for radiation chemical processes. A survey is given on U. S. and Belgian chemonuclear reactors. Furthermore, some construction proposals are discussed. It appears that chemonuclear reactors are primarily power reactors since only a small fraction of the energy produced in the core can be transformed in radiation chemical processes. (auth)

6119 THE INFLUENCE OF VOIDS BETWEEN CORE AND REFLECTOR ON THE CRITICALITY OR REACTIVITY OF A REACTOR. O. Machnig and P. Handge (Arbeitsgemeinschaft BBC-Krupp, Mannheim, Ger.). Atomkernenergie, 6: 434-40(Nov. 1961). (In German)

A method for the computation of the reactivity effect of voids in various forms between core and reflector is shown, by which numerical results can be obtained with ease. The proposed method is based on the diffusion theory considering the effect of anisotropy in vacuum. Initially it is demonstrated that the proposed method leads to practicable results by application on a spherical reactor with spherically shaped gap. The results are compared with those obtained by the P_1-, P_3-, and P_5- approximation of the monoenergetic transport theory by D. Emendörfer and M. Ritzi. Finally the method is applied to a monolateral reflected cylindrical reactor with semispherical void and reflector formed as spherical shell. (auth)

6120 CONCERNING YVON'S APPROXIMATION METHOD. H. Kellner (Österreichische Hochschule, Vienna). Atomkernenergie, 6: 441-3(Nov. 1961). (In German)

The angular distribution is divided in $\psi^+(x,\mu)$ and $\psi^-(x,\mu)$ for $\mu > 0$ respectively $\mu < 0$. Using Yvon's approximation method the transport equation yields a system of differential equations which is solved generally in the N-th approximation. Using this solution, the angular distribution, the neutron flux, and current were calculated. (auth)

6121 CONCERNING THE WEIGHT ECONOMY MEASURES FOR SOURCE SHIELDING. E. Beynam. Atomkernenergie, 6: 443-4(Nov. 1961). (In German)

The weight of shielding layers can be reduced by an appropriate choice of the shape of these layers. Such a case is discussed. (auth)

6122 THE PROPAGATION OF NEUTRON MULTIPLICATION IN THE PULSED NEUTRON INJECTED CORES. Toshikazu Shibata (Osaka Univ.), Tokua Suita, and Fumio Hirayama. J. At. Energy Soc. Japan, 3: 835-40(Nov. 1961). (In English)

By using an analog computer two-group calculations were carried out on the transient behavior of neutron multiplication in bare cores of a swimming pool type reactor. The multiplication was caused by a short burst of fast neutrons on the central plane. The propagation of neutron multiplication from the source plane to the outer boundaries was found. The propagation velocity of neutron multiplication decreased with the increasing core size up to the critical. The maximum thermal neutron flux caused by the pulsed neutron injection did not show a strong dependency on the core size. (auth)

6123 METHODS FOR CALCULATING THE REACTOR PERIODS OF MULTI-REGION REACTORS. Shigehiro An (Tokyo Univ.). J. At. Energy Soc. Japan, 3: 841-8(Nov. 1961). (In Japanese)

Methods for calculating the reactor periods of multiregion reactors by multigroup theory are discussed. It is usually very difficult to solve the kinetic problems of multiregion reactors by a strict and straight forward method. Therefore, two kinds of approximation, the perturbation method and the method of coupled system parameters, are used under the condition that the system is nearly critical. In the former, introducing a vector, the elements of which consist of neutron fluxes and delayed neutron precursor concentrations, a formula is derived which relates the variation of the reactor periods to the perturbation conditions. The equation relating the reactivity with the steady reactor period is also obtained. In the latter, the coupled parameters concerning the neutron source terms of every energy group in every region are defined, and the kinetic equation which gives the steady period is derived using such parameters. (auth)

6124 THE NUCLEAR REACTOR AS A HIGH INTENSITY SOURCE FOR DISCRETE GAMMA RAYS UP TO 11 MEV. L. Jarczyk, H. Knoepfel, J. Lang, R. Mueller, and W. Woelfli (Technische Hochschule, Zurich). Nuclear Instr. & Methods, 13: 287-96(Oct. 1961). (In English)

The use of a nuclear reactor as a potential high-intensity source of discrete gamma rays for energies up to 11 Mev is discussed in the light of investigations undertaken. The advantages and disadvantages inherent in such sources are compared with those associated with other gamma sources for this energy region, such as, in particular, proton capture reactions. The following features indicate interesting possibilities in employment of sources: (a) a large variety of discrete gamma rays of various energies exists (there are about 10 lines between 3 and 11 Mev); (b) background is low (for background quanta above 4 Mev, the line to background intensity ratio ranges up to about 10); (c) collimation is good (the beam can be collimated along a 4 m path) and (d) intensity is very high (about a 1000-fold that of (p,γ)-sources in practice). The absolute intensity can with ease be calibrated to within 10%. Experimental details are given, e.g. of collimation, target container and target material, and an arrangement is proposed whereby an appreciable increase of line to background intensity can be attained. (auth)

6125 THE THERMAL UTILIZATION IN A RECTANGULAR CELL. A. Pazy and S. Goshen (Israel Atomic Energy Commission, Tel Aviv). Nuclear Sci. and Eng., 11: 357-61(Dec. 1961).

An investigation is conducted regarding the equivalent-cell assumption that is used in reactor calculations. The thermal utilization is calculated using the real cell shape and allowing absorption in the moderator. The results show that for heavy water and graphite lattices, the correction caused by the equivalent-cylindrical-cell assumption is of the same order of magnitude as the correction caused by the neglect of absorption in the moderator. (auth)

6126 THE DETERMINATION OF THE PERIOD-REACTIVITY RELATION AND OPEN-LOOP REACTOR TRANSFER FUNCTION FROM ROD-DROP DECAY DATA. W. J. Fader and R. C. Harrison (Pratt & Whitney CANEL, Middletown, Conn.). Nuclear Sci. and Eng., 11: 405-14 (Dec. 1961).

Reactor period-reactivity relations and open-loop transfer functions may be determined directly by numerical integration of "rod-drop" neutron decay data without analysis of delayed neutron period and abundance values. Period-reactivity relations obtained by this method for two critical assemblies with and without beryllium in the core and reflector are compared with corresponding results calculated from the "in-hour" equation. Results of the application of the rod-drop experiment to the determination of the open-loop reactor transfer function are given for the beryllium-moderated assembly. (auth)

6127 ON THE STABILITY OF HOMOGENEOUS NUCLEAR REACTORS WITH NON-LINEAR REACTIVITY DEPENDENCE ON TEMPERATURE. Henri B. Smets (O.E.E.C., European Nuclear Energy Agency, Paris). Nuclear Sci. and Eng., 11: 428-33(Dec. 1961).

The stability and instability properties of homogeneous nuclear reactors with a single temperature coefficient of reactivity that is temperature dependent are studied by means of Liapounoff's second method. The special case of a temperature coefficient that is linearly dependent on temperature is solved completely for a space-independent model and it is shown that all solutions are bounded and tend asymptotically to a constant, if the reactivity decreases as the temperature approaches large values. In some conditions, the reactor has two stable equilibrium points. (auth)

6128 RE: THERMAL NEUTRON FLUX DEPRESSION BY ABSORBING FOILS AND FLUX PERTURBATIONS BY THERMAL NEUTRON DETECTORS. R. H. Ritchie (Oak Ridge National Lab., Tenn.) and G. R. Dalton. Nuclear Sci. and Eng., 11: 451-2(Dec. 1961).

Two methods for determining the thermal neutron flux depression caused by the presence of coin-shaped detectors are discussed. It is shown that the approximations involved in the methods restrict the first method to cases in which the radius/thickness (r/t) ratio of the coin is $\gg 1$, and the second method to cases in which r/t ~ 1. It is found that there is a range of r/t over which the two methods yield comparable results. (T.F.H.)

6129 FUEL-BREEDER FUEL ELEMENT FOR NUCLEAR REACTOR. Australian Patent 216,401. July 24, 1957.

A fuel element is designed to facilitate breeding reactor fuel. The fuel element is comprised of a container, a central core of fertile material in the container, a first bonding material surrounding the core, a sheet of fissionable material immediately surrounding the first bonding material, and a second bonding material surrounding the fissionable material and being in contact with said container.

6130 NEUTRONIC REACTOR CONTROL. Australian Patent 216,622. Oct. 5, 1956.

An apparatus is designed for indicating the approach to prompt criticality of a neutronic reactor. The apparatus comprises means for oscillating an absorber in the reactor, a detector for measuring neutron flux in the reactor, two channels into which the output of the detector can be directed, one of which includes a narrow band filter with band pass frequency equal to that of the oscillator, and means for indicating the ratio of the signal produced by the channel which includes the filter to the signal produced by the other channel, which ratio constitutes an indication of the approach to prompt criticality.

6131 FUEL FOR NEUTRONIC REACTORS AND PROCESS OF MAKING. Australian Patent 216,706. Oct. 5, 1956.

A fuel material for nuclear reactors consists of $UO_{2.00}$ suspended in a sodium-containing liquid metal.

6132 NEUTRONIC REACTOR. Australian Patent 218,462. July 12, 1957.

A neutronic reactor of the heterogeneous type and employing replaceable tubular fuel elements and heavy water as a coolant and moderator and fuel elements therefor are described. A plurality of fuel tubes, having their axes parallel, extend through a tank type pressure vessel which contains the liquid moderator. The fuel elements are disposed within the fuel tubes in the reactive portion of the pressure vessel during normal operation and the fuel tubes have removable plug members at each end to permit charging and discharging of the fuel elements. The fuel elements are cylindrical strands of jacketed fissionable material having helical exterior ribs. A bundle of fuel elements are held within each fuel tube with their longitudinal axes parallel, the ribs serving to space them apart along their lengths. Coolant liquid is circulated through the fuel tubes between the spaced fuel elements. Suitable control rod and monitoring means are provided for controlling the reactor.

6133 FUEL-BREEDER ELEMENT FOR A NUCLEAR REACTOR. Australian Patent 218,926. July 23, 1957.

A nuclear reactor fuel element is designed for the breeding of reactor fuel material. The fuel element is comprised of a container of low thermal neutron absorption cross-section, a central core of solid fertile material, and a non-aqueous fluid fuel composition disposed between the core and the walls of the container.

6134 PLATES WITH OXIDE INSERTS. Australian Patent 221,302. Aug. 28, 1957.

Planar type fuel assemblies are designed for nuclear reactors, particularly those comprising fuel in the oxide form such as thoria and urania. The fuel assembly consists of a plurality of parallel spaced fuel plate members having their longitudinal side edges attached to two parallel supporting side plates, thereby providing coolant flow channels between the opposite faces of adjacent fuel plates. The fuel plates are comprised of a plurality of longitudinally extending tubular sections connected by web portions, the tubular sections being filled with a plurality of pellets of the fuel material and the pellets being thermally bonded to the inside of the tubular section by lead.

6135 NEUTRONIC REACTOR CONTROL. Australian Patent 222,477. Mar. 13, 1957.

Means is designed for "shadow" control of a nuclear reactor. The control means comprises a plurality of elongated rods disposed adjacent and parallel to each other, each of these rods consisting of alternate equal-length sections of neutron absorbing materials and equal-length sections of neutron permeable materials together with means for longitudinally positioning the rods relative to each other.

6136 COMPOSITE ELEMENT AND METHOD OF MANUFACTURE. Australian Patent 222,604. May 8, 1957.

A method is given for the manufacture of nuclear reactor fuel elements by agglomerating uranium dioxide powder with a readily heat-decomposable resinous binder such as polyvinyl alcohol and pressing in a die to approximately 70% theoretical density. The binder is removed by heating the compacts to a temperature of 500 to 900°C in free flowing carbon dioxide gas, after which the compacts are sintered in a non-oxidizing atmosphere at a temperature of approximately 1700°C until a density of 9.86 gram per cubic centimeter is achieved. The sintered compacts are placed in a tube and the ends thereof are sealed.

6137 METHOD AND APPARATUS FOR REACTOR SAFETY CONTROL. Australian Patent 222,673. July 24, 1957.

A nuclear reactor control device is disclosed which releases a neutron absorbing gas in the event the reactor flux exceeds a predetermined value. The device consists of a stainless steel or aluminum can containing a cadmium-plated high-pressure chamber, a low-pressure chamber, and a normally sealed passage connecting the two chambers. A heating element responsive to neutron flux is so arranged that when the flux becomes excessive, the temperature of the heating element becomes sufficient to unseal the passage and release a neutron absorbing gas such as boron trifluoride (BF_3) enriched in B^{10}.

6138 METHOD OF OPERATING NUCLEAR REACTORS. Australian Patent 223,336. Aug. 14, 1957.

A method is given for obtaining enhanced utilization of natural uranium in heavy water moderated nuclear reactors. The method comprises charging the reactor with an equal number of fuel elements formed of natural uranium and of fuel elements formed of uranium depleted in U^{235} to the extent that the combination will just support a chain reaction, operating the reactor until the rate of burnup of plutonium equals its rate of production, processing the fuel elements to recover plutonium, discarding the depleted uranium, reforming the remaining uranium into fuel elements, charging these fuel elements into a reactor along with an equal number of fuel elements formed of uranium depleted in U^{235} to the extent that the combination will just support a chain reaction, and continuing reuse of the uranium as aforesaid until it will no longer support a chain reaction when combined with an equal quantity of natural uranium.

6139 MULTISTAGE FLUIDIZED BED REACTOR. Australian Patent 224,625. Mar. 14, 1958.

A multistage fluidized bed reactor is designed in which each of a number of stages is arranged with respect to an associated baffle that a fluidizing gas flows upward and a granular solid downward through the stages and baffles, whereas the granular solid stops flowing downward when the flow of fluidizing gas is shut off.

6140 NUCLEAR REACTOR CORE DESIGN. Australian Patent 226,558. Apr. 11, 1958.

An improved core design is given for a sodium-cooled, graphite-moderated nuclear reactor. The core comprises a number of blocks of moderator material, each block being in the shape of a regular prism. A number of channels, extending the length of each block, are disposed around the periphery thereof. When several blocks are placed in contact to form the reactor core, the channels in adjacent blocks correspond with each other to form closed conduits extending the length of the core. Fuel element clusters are disposed in these closed conduits, and liquid coolant is forced through the annulus between the fuel cluster and the inner surface of the conduit. In a preferred embodiment of the invention, the moderator blocks are in the form of hexagonal prisms with longitudinal channels cut into the corners of the hexagon. The main advantage of an "edge-loaded" moderator block is that fewer thermal neutrons are absorbed by the moderator cladding, as compared with a conventional centrally-loaded moderator block.

6141 NUCLEAR REACTOR INCLUDING A PACKAGE SAFETY DEVICE. Australian Patent 228,060. Dec. 11, 1957.

A safety device for a nuclear reactor is designed which consists of a tube having two chambers separated by a barrier comprising an annulus of stainless steel surrounding a copper disk, and a mass of fissionable material in thermal contact with the copper disk. One of the two chambers contains a moderator and is adapted to be located in a region of high reactivity in the reactor and the other chamber under high pressure a gas having a high neutron capture cross section and is adapted to be located in a region of low reactivity in the reactor.

6142 STEAM FORMING NEUTRONIC REACTOR AND METHOD OF OPERATING IT. Australian Patent 230,559. Aug. 1, 1958.

The reactor is liquid moderated and cooled by a steam-forming coolant and is designed to produce steam from the coolant directly within the active portion of the reactor while avoiding the formation of bubbles in the liquid moderator. This reactor achieves inherent stability as a result of increased neutron leakage and increased resonance absorption in the U^{238} fuel with the formation of bubbles. The invention produces certain conditions under which the formation of vapor bubbles as a result of a neutron flux excursion form the injection of a reactivity increment into the reactor will operate to nullify the reactivity increment within a sufficiently short period of time to prevent unsafe operating reactor conditions from developing. This is obtained by disposing a plurality of fuel elements within a mass of steam-forming coolant in the core with the ratio of the volume of steam coolant to the volume of fissionable isotopes being within the range yielding a multiplication factor greater than unity and a negative reactivity to core void coefficient at the boiling temperature of the coolant.

6143 NEUTRONIC REACTOR FUEL ELEMENT. Australian Patent 230,595. Mar. 5, 1959.

A fuel element assembly is designed for use in pressurized water heterogeneous type reactors. The element comprises a cladding tube with a plurality of fuel pellets of a short, right cylinder form inserted in the tube. The inner wall of the cladding tube engages each of the pellets independently and spacedly from the adjacent pellets. The separation of the pellets is caused by stretching and slightly inward necking the tube wall. The amount of separation is measured by a predetermined amount of differential thermal expansion between the pellets and the cladding tube.

6144 GAS-COOLED NEUTRONIC REACTOR. Australian Patent 231,811. Feb. 10, 1959.

The active portion of this reactor is comprised of a solid refractory moderator having a plurality of coolant channels passing therethrough; a multiplicity of discreet fissionable fuel bearing masses suspended in tension in the channels containing from 1 to 4 weight per cent U^{235}, the fuel being of the refractory type such as UO_2; a gaseous coolant adapted to be continuously passed through the channels; and means to control the reactivity of the active portion.

6145 COMPOSITE FUEL ELEMENT. Australian Patent 232,502. Apr. 17, 1958.

The fuel element comprises a flat filler plate having a plurality of compartments therein and a pair of cladding plates of a size to completely enclose the compartments. Fissile material is located in each of the compartments and unbonded to the filler plate and the cladding plates. The cladding plates are secured to the filler plate and cooperate to completely enclose the fissile material in the compartments.

6146 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Philip Ross Simpson (to United Kingdom Atomic Energy Authority). British Patent 884,769. Dec. 20, 1961.

A plate-type fuel element is designed for heavy water-moderated and -cooled material testing reactors. The fuel element comprises a series of connected and spaced coaxial fuel tubes formed by curved plates containing fissile material and secured along their edges to radial support plates. The fuel plates are composed of an aluminum–uranium alloy clad with aluminum. The advantages of this fuel element over other plate-type fuel elements are improved mechanical stability, use of welding in place of brazing, heat conduction by radial support plates, and space within the element for specimen thimbles or tubes. (D.L.C.)

6147 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR SHIELDING. Herbert Chilvers Knights and Alfred Johnston (to United Kingdom Atomic Energy Authority). British Patent 884,855. Dec. 20, 1961.

A shield between the reactor and heat exchangers, both of which are contained within a common pressure vessel, is designed so that coolant can be passed to the heat exchangers without substantial pressure drop. The shield comprises a solid center portion surrounded by an outer ring of shielding to leave annular passageways; the passageways are overhung by another shielding ring on the heat exchanger side. (D.L.C.)

6148 IMPROVEMENTS RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Graham Coates and Richard Anthony Skinner (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 884,969. Dec. 20, 1961.

A reactor fuel element comprising an assembly of ceramic fuel pellets in a hollow metal casing is designed for better casing support. The pellets are formed with recesses, and the casing is deformed inwards over the recesses to prevent axial movement of the pellets. The recesses may be formed either by chamfering the pellet ends or by forming grooves around the pellets. (D.L.C.)

6149 IMPROVEMENTS IN OR RELATING TO GAS COOLED NUCLEAR REACTORS. Cedric Euan Iliffe (to United Kingdom Atomic Energy Authority). British Patent 885,776. Dec. 28, 1961.

A gas-cooled, water-moderated reactor is described which has advantages over the heavy water-moderated and light water-moderated reactor types. The moderator consists of 70 to 95 wt % D_2O and balance H_2O. In the preferred form of the reactor, the moderator is 90 wt % D_2O and 10 wt % H_2O, and the fuel is uranium oxide plates of twice-natural enrichment and canned in beryllium. The moderator to uranium volumetric ratio is 10 to 1, and the reactor is cooled by CO_2 at 37 atm pressure. (D.L.C.)

6150 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Peter Raymond Joseph French (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 885,882. Dec. 28, 1961.

A gas-cooled, graphite-moderated reactor is designed for reducing the amount of Wigner energy stored in the moderator. In this reactor design, the coolant is caused to flow along the fuel channels and then to backtrack in contact with the graphite walls so that the wall temperature is increased and the Wigner energy is reduced. The backward flow path is defined by a baffle which separates the graphite wall and the fuel element. (D.L.C.)

6151 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. John Alan Dodd (to United Kingdom Atomic Energy Authority). British Patent 885,885. Dec. 28, 1961.

A heat exchange apparatus is described for removing fission product heat from the fuel elements in a gas-cooled reactor on shutdown or on cessation of forced coolant circulation through the main heat exchanger. The apparatus comprises a secondary heat exchanger, valved ducting connecting the heat exchanger with the reactor core, and a header tank for supplying heat exchange fluid to the heat exchanger. The heat exchanger is positioned above the level of the core for establishing a coolant flow there between by thermosiphoning, and the header tank is likewise above the exchanger so that the heat exchange fluid is returned to the tank after being heated in the exchanger. The apparatus is designed so that it would still be effective in case of tilting movement as on a ship, and a plurality of apparatuses may be provided around the reactor to cover the case in which the ship sank nose or stern first. (D.L.C.)

6152 CONTROL METHOD FOR A BOILING WATER REACTOR. A. Huet. First Add. 72,557 to French Patent 1,188,113. Apr. 14, 1960.

The French Patent 1,188,113 describes a boiling water reactor in association with a thermal power station. The steam demand of this station is controlled by an organ connected with the organs controlling the reactivity of the reactor. According to the present addition, these organs controlling the reactivity may be associated with means permitting the measurement of the variations of the working pressure of the power station. In the case that the reactivity of the reactor is controlled by a vibration induced in the fuel elements, this vibration may extend to the coolant passing through the reactor. Preferably, the means for decreasing the steam demand or said pressure does not begin to work before the means for reducing the activity has begun to work. (NPO)

6153 CONTROL METHOD FOR A BOILING WATER REACTOR. A. Huet. Second Add. 72,942 to French Patent 1,188,113. Sept. 21, 1960.

The French Patent 1,188,113 describes a boiling water reactor provided with water-steam separators comprising a helical ramp; fertile material is introduced into the reactor in order to control its reactivity. According to the present addition, the fertile material is introduced not via separate tubular circuits but directly into the boiling water of the reactor. (NPO)

6154 BOILING WATER REACTOR. A. Huet. First Add. 72,545 to French Patent 1,189,249. Apr. 14, 1960.

The French Patent 1,189,249 describes a boiling water reactor comprising water-steam separators positioned between the vertical fuel elements in the boiling water, each separator being constituted by a vertical tube provided on the outside with a helical rib; the liquid is thereby forced to execute a gyratory movement, so that the steam enters the tube via lateral openings in the tube wall. The present addition provides progressive variations of the distances apart of adjacent turns of the helical rib; these variations may be effected on each individual separator tube as a function of its length, or from tube to tube depending on the position of each tube in the reactor. (NPO)

6155 RETAINING BELT LINK FOR THE MODERATOR STRUCTURE PILE OF A NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,216,839. Apr. 27, 1960.

A retaining belt link comprises a series of end plates, a corresponding number of coaxial tubes for receiving compressive loads, and a plurality of tie rods designed to support tensile loads and arranged in a number of sets. These coaxial tubes and tie rod sets are mounted between the end plates in such a way that the latter transmits the load from the tubes to the rods and vice versa. To this end, the tubes and rod sets are mounted alternately and act in series. Preferably, the link comprises only two sets of tie rods and tube; in this case, the end plates connect on the one hand each set of tie rods to an end of the said tube and on the other hand to one of a pair of attaching members for interconnecting adjacent links. The tensile load applied to the tie rods is thus transmitted by the end plates to the tube in the form of a compressive stress. (NPO)

6156 ELECTRIC NETWORK FOR SIMULATING THE KINETIC BEHAVIOUR OF A NUCLEAR REACTOR. (to Siemens & Halske A. G.). French Patent 1,217,960. May 6, 1960.

An electric network for simulating the kinetic behavior of a nuclear reactor is a special form of a Wheatstone bridge. The terminals of one of the diagonals of the bridge are fed with a voltage representing the neutron flux in the reactor. Two adjacent arms of the bridge, connected in series between said terminals, comprise three electric resistances in series, the middle resistance serving also as a potentiometer and having a sliding contact that constitutes one of the terminals of the second diagonal of the bridge and whose position corresponds to the reactivity of the reactor; the other two resistances are equal in value. The other two arms of the bridge, connected between the terminals of the first diagonal, comprise two equal resistances in series; the point of connection of these resistances constitutes the other terminal of the second diagonal. In parallel with one of the arms involving the potentiometer is connected a series of elements, each consisting of a condenser in series with a resistance, and each corresponding to the behavior of one of the delayed neutron groups. The potential between the terminals of the second diagonal is fed to an amplifier having an output voltage that controls a motor displacing a sliding contact that moves over a resistance and constitutes a terminal of the generator of the variable voltage that represents the neutron flux and is fed to the bridge. (NPO)

6157 DEVICE PLACED ON THE CHARGING CARRIAGE SYSTEM OF A NUCLEAR REACTOR FOR PLACING IT EXACTLY IN A POSITION CORRESPONDING WITH THE CHARGE HOLES OF THE REACTOR. (to Maschinenfabrik Augsburg-Nürnberg A. G.). French Patent 1,222,147. June 8, 1960.

The charging carriage system comprises a first carriage movable in a first direction and is provided with rails for a second carriage movable in a direction perpendicular to the first direction, the charging chamber for the fuel elements of the nuclear reactor being positioned on the second carriage; propulsion means for these movements are mounted on the carriages. In order to bring the charging opening into exact alignment with one of the charging holes in the top of the reactor, the carriages are first brought within a tolerance of about 15 mm to a predetermined charging hole. The exact alignment is performed by vertical slidable bolts with conical extremities mounted in each of these carriages, each of which bolts may be locked in one of a series of holes provided along a straight line parallel to the rails of the carriage in question. The locking movement is controlled by means also provided on these carriages. Preferably the hole occupied by the bolt at a given moment is indicated by a mechanical counter, comprising a feeling roller penetrating elastically into the locking holes. (NPO)

6158 PROCESS AND DEVICE FOR CONTROLLING THE TEMPERATURE OF SLOW NEUTRONS. (to Licentia Patent-Verwaltungs G.m.b.H.). French Patent 1,223,882. June 21, 1960.

The process for controlling the temperature of slow neutrons in an experimental nuclear reactor consists in controlling the temperature of a part of the moderator, this moderator enclosing suitably the experimental hole of the reactor. Preferably, an experimental reactor according to said process comprises a reflector enclosing a cylindrical annular fuel zone, a thermal insulation covering the inner edge of said fuel zone, and an inner annular moderator (reflector) zone enclosed by said insulation. The latter moderator zone is provided with electrical heating means controlling its temperature and encloses a central experimental hole for the samples to be investigated. (NPO)

6159 RELIEF DEVICE FOR DISCHARGING VERTICAL FUEL CHANNELS FROM THE BOTTOM OF A NU-

CLEAR REACTOR. (to Commissariat à l'Energie Atomique). French Patent 1,224,960. June 28, 1960.

It has been shown that, in a nuclear reactor, having vertical channels and being generally charged and discharged from the top, the fuel elements may become jammed in the channel during a reactor incident. A relief device is described for ensuring that the fuel elements can be discharged from the bottom of the reactor. This device comprises a first permanent support attached to the lower end of each channel and not interfering with the free passage of the channel, and a second, spline-shaped support piece locked in place in the said first support and supporting the load of the fuel elements in the channel. This second support piece comprises at least one zone of lower mechanical resistance, so that remotely controlled shears can cut through it in order to give free passage for the fuel elements. The locking means may be spring loaded balls located in protruding lugs, the balls resting against shoulders provided in the permanent support. (NPO)

6160 DEVICE FOR THE REMOVAL OF A NUMBER OF BALLS IN PARTICULAR FROM NUCLEAR REACTORS. (to W. C. Heraeus G.m.b.H.). French Patent 1,225,402. June 30, 1960.

In a nuclear reactor having ball-shaped fuel elements filled into the reactor container, it is necessary, at a given moment, to remove a predetermined number of the balls from the reactor space. It has been shown that the opening for discharging the balls must have a dimension at least from five to ten times the diameter of the balls, in order to avoid jamming of the balls. A device is described for the removal of a number of balls from a container, comprising a disk obturating a lower opening of the container, the disk having an opening with a width a little greater than the diameter of the balls. The removal of the balls is effected by rotation or axial displacement of the disk. Preferably, the opening has the form of a radial slot having a length at least three times the diameter of the balls. The disk may also have a thickness a little greater than the diameter of the balls and may cover with half its surface the bottom of a discharge cylinder of the container passing through the walls of the latter. After receiving balls into the slot, the disk is turned so as to bring the balls outside the discharge cylinder. (NPO)

6161 IMPROVEMENTS RELATING TO A BURST-SLUG DETECTING DEVICE FOR GAS COOLED REACTORS. (to Commissariat à l'Energie Atomique). French Patent 1,225,768. July 4, 1960.

In order to detect burst-slugs during the operation of a gas cooled reactor having a great number of fuel element channels, gas samples coming each from an individual channel must be investigated for all channels during a relatively short period. In order to reduce the number of measuring instruments necessary, a part of the sample lines leading the samples from each fuel channel to the detecting system is divided into several groups. During a first normal prospecting program the sample lines of each group are coupled together in such a way that a measuring instrument can be connected simultaneously with all of them; the several groups are investigated successively. In the event that an abnormal activity is detected in a determined group, the channel responsible is determined in a second program by successive investigation of each of the channels of the group in question, alternately with an investigation of each of the other groups according to the first program but naturally now with a reduced frequency; the same instrument serves for all investigations. Finally, according to a third program, the first program for the groups is pursued, the responsible channel being excluded, alternately with checking of this channel with an increased frequency in order to follow the development of the burst. (NPO)

6162 DISCHARGE DEVICE, ESPECIALLY FOR THE FUEL ELEMENTS OF A NUCLEAR REACTOR. (to Commissariat à l'Énergie Atomique). French Patent 1,225,784. July 4, 1960.

A discharge or lifting device is described for removing fuel elements from vertical channels of a nuclear reactor. This device comprises a heavy cylindrical body fitted at its lower end with at least three vertically and symmetrically placed bars. Each bar has two lateral opposite surfaces, which may be brought into contact with two opposite free vertical surfaces of the article to be lifted, and has at each of these surfaces a recess, each containing a small ball or a small roller. The ball is freely movable inside said recess touching the said vertical surfaces of the article, so that at the moment when the device is lifted this ensures that the balls press against the article and thus couple it with the lifting device by wedging. (NPO)

6163 METHOD AND DEVICE ENSURING THE SAFETY OF NUCLEAR REACTORS IN PARTICULAR OF REACTORS COOLED BY CARBON DIOXIDE. L. Denis. First Add. 73,963 to French Patent 1,226,423. Oct. 31, 1960.

The French Patent 1,226,423 describes an auxiliary cooler for a reactor cooled by carbon dioxide, this cooler being built in a by-pass of the cooling circuit and enclosing a condensed cooling medium, constituted preferably also by carbon dioxide. This cooling medium is able to absorb the heat developed in the event of a reactor accident, and said liquid carbon dioxide is formed on the surfaces of cooling elements that are in connection with a refrigerating apparatus comprising one or several cold-accumulators. The present addition describes several forms of such auxiliary coolers, with cold-accumulators each enclosing a mass that can be held at a very low temperature. In a first form of the invention, this mass may be divided into elements, e.g., balls, cylindrical rings or bricks; in a second form of the invention, this mass may be liquid or plastic e.g., liquefied gas, mineral oil, glycerine, tar, or may be constituted by a mixture of finely divided solid material with a liquid or a plastic material. (NPO)

6164 METHOD AND DEVICE ENSURING THE SAFETY OF NUCLEAR REACTORS IN PARTICULAR OF GAS COOLED REACTORS. L. Denis. Second Add. 74,947 to French Patent 1,226,423. Jan. 23, 1961.

The French Patent 1,226,423 described auxiliary cooling means for a gas-cooled nuclear reactor. These auxiliary cooling means comprised a container enclosing a mass held at a low temperature and able to absorb the heat developed inside the reactor during a reactor incident. According to the present addition, this mass is constituted by metal having a high ratio of surface to volume, e.g., sheets. Means are provided for filling said container with a refrigerating fluid, for cooling the said mass by chilling said refrigerating fluid with the aid of a refrigerating apparatus, and for evacuating the container after the mass has been cooled to a predetermined low temperature. This last measure is taken in order to prevent heat convection from the container wall to the said cold storing mass. For compensating the losses of cold from said mass, the said refrigerating apparatus feeds auxiliary cooling coils passing through the container. (NPO)

6165 DEVICE FOR CHARGING AND DISCHARGING THE FUEL ELEMENTS OF A NUCLEAR REACTOR. (to

Société des Forges et Ateliers du Creusot). French Patent 1,228,195. Aug. 26, 1960.

A device is described for charging and discharging the fuel elements, each vertically positioned in one of a group of parallel reactor channels, through a single upper opening in the reactor vessel wall, this opening being in alignment with a hole in the top of the core situated in the center of said group. A tubular support is rotatably mounted with its two ends, respectively, in said opening and in said centering hole. At this support a curved charging tube is articulated, so that this charging tube may connect the lower end of a tubular chute, mounted in the upper portion of said tubular support, with the end of each reactor channel, these ends lying in a portion of a spherical surface having its center in the articulation axis of the charging tube. In order to avoid too sharp variations in direction of the charging path formed by said tubular chute, the charging tube and the reactor channels, the charging tube is suitably curved with a point of inflection at its middle. The said tubular chute is axially displaceable and presses against an edge of the upper extremity of the charging tube in order to create a couple tending to apply its lower end against a spiral-shaped guiding rib mounted on said spherical surface for bringing this lower end successively in front of all the channel extremities. (NPO)

6166 DEVICE WITH CONTROLLED WATER CIRCULATION FOR BOILER SYSTEMS. A. Huet. French Patent 1,228,326. Aug. 29, 1960.

A boiler system which is in particular used in connection with nuclear reactors is composed of a plurality of columns, each comprising an outer casing through which the heating fluid passes from the top to the bottom and which encloses near the top the economizer followed by the boiling stage and finally by the superheater stages. The boiling stage in such systems suitably comprises a water drum surrounded by a plurality of boiler tubes that are in communication with said drum at their extremities, so that a natural circulation takes place through the boiler tubes and this water drum. The said circulation is increased by injection of supplementary water into these tubes with the aid of an injection pump to which the water is delivered from the bottom of said water drum. According to another embodiment, the boiler stage comprises not a water drum but a single boiling tube which is provided with helical fins for separating the steam from the water, the separated water being led down via a special circuit situated outside the column. The supplementary water is injected at the lower extremity of said single boiling tube. (NPO)

6167 IMPROVEMENTS RELATING TO THE CONTROL OF NUCLEAR REACTORS. (to Babcock & Wilcox Co.). French Patent 1,228,359. Aug. 29, 1960.

In order to compensate the effects of the negative temperature coefficient of reactivity and of the xenon and samarium that are developed during the reactor operation, a burnable poison is added to the fuel elements of a nuclear reactor, while a soluble poison of controlled concentration is maintained in the pressurized water constituting the moderator and circulating through the reactor core. This soluble poison comprises preferably boric acid, the burnable poison comprising boron. This burnable poison in the fuel elements may be distributed in the nuclear fuel or in the canning material. (NPO)

6168 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Babcock & Wilcox Co.). French Patent 1,228,851. Jan. 2, 1960.

In a pressurized water reactor working with ordinary water and as converter according to the $Th^{232}-U^{233}$ or $U^{238}-P^{239}$ cycle, the fissile and fertile materials are mixed and used in the form of oxides. This mixture is shaped suitably into the form of rods which are clad and united parallelly and successively to form fuel element assemblies, each having an outer casing with a nearly square cross section. These fuel element assemblies are replaceable. Each of the outer casings of these assemblies is provided on both its extremities with cylindrical fittings engaging respectively into an upper and a lower support structure; each of these structures serves also for distributing the water flow which passes not only through the fuel assemblies but also through the space between said assemblies. In connection with other structural means, the said support structures form respectively the entrance and the exit header systems for the ordinary water that serves both as coolant and as moderator. (NPO)

6169 PRESSURE BALANCING DEVICE FOR NUCLEAR REACTORS HAVING A HIGH WORKING PRESSURE. (to Siemens-Schuckertwerke A. G.). French Patent 1,229,281. Sept. 6, 1960.

In a nuclear reactor having a coolant different from the moderator liquid, separation means are provided to balance the pressures of the coolant and the moderator liquid. These separation means comprise preferably two balancing reservoirs in communication at the bottom, each being partly filled with a separation liquid. The upper part of the first reservoir is full of and in communication with the coolant, while the upper part of the second reservoir is filled with a protecting gas that is in contact via appropriate ducts with a free surface of the moderator liquid inside a third reservoir. According to another embodiment, the three reservoirs are placed inside each other, that is to say, the first reservoir is closed and encloses the third, which is open at the top and contains the moderator liquid. The annular space between the walls of the first and the third reservoir is filled with the separating liquid, while the second reservoir is defined by a bell-shaped structure that is open at the lower end and dips into said separating fluid. Preferably, this bell-shaped structure floats in the moderator liquid by virtue of its having a central part that protrudes into the third reservoir. (NPO)

6170 NUCLEAR REACTOR IN WHICH THE HEAT DEVELOPED BY THE FISSION IS TRANSMITTED TO THE COOLING OR WORKING CIRCUIT BY THERMAL RADIATION. (to Siemens-Schuckertwerke A. G.). French Patent 1,229,381. Sept. 6, 1960.

The heat is transmitted from the fissile material to the fuel element casing exclusively by thermal radiation. Suitably, the fissile material is used in the form of cermets or carbides, alone or mixed with graphite, these forms having a high thermal resistance. These materials are shaped into elements, each of which is supported on its two extremities by suitable graphite blocks holding it at a given distance from the inner wall of a stainless steel tube enclosing the elements. This steel tube is positioned inside a reactor cooling channel, the outside of said steel tube being in contact with the coolant circulating in this channel. Suitably, several fuel units of the kind described are placed inside each steel tube alternately with spacer plugs, fixed inside the tube by crimping it on these plugs, which are preferably perforated for heat equalization. (NPO)

6171 PROCESS AND DEVICE FOR MEASURING THE PERIOD OF A NUCLEAR REACTOR. (to Zovody V. I. Lenina). French Patent 1,229,777. Sept. 9, 1960.

The period meter comprises an ionization chamber that is movable along a path in the proximity of the reactor core and so chosen that the neutron flux varies exponentially with distance along this path. The speed at which the ionization chamber has to be moved for its output to remain constant corresponds to the reactor period. In the embodiment the output signal of said chamber is compared with a reference signal, and the difference signal, after amplification, controls a servo-motor that displaces the ionization chamber, so that said difference signal has a minimum absolute value. (NPO)

6172 PROCESS AND DEVICE FOR THE AUTOMATIC CONTROL OF THE PERIOD OF A NUCLEAR REACTOR. (to Zavody V. I. Lenina). French Patent 1,229,778. Sept. 9, 1960.

According to this process an ionization chamber is movable along a path in the proximity of the reactor core, the neutron flux varying exponentially with distance along this path. The movement of the said ionization chamber is controlled according to a predetermined program. The neutron flux signal from this chamber is compared with a reference signal and the difference signal is used to control the servo-system for the reactivity of the reactor in order that this difference signal shall be reduced to and held at a minimum level. The period of the reactor is a function of the speed of displacement of the ionization chamber. (NPO)

6173 PROCESS AND DEVICE FOR THE AUTOMATIC CONTROL OF A NUCLEAR REACTOR. (to Zavody V. I. Lenina). French Patent 1,229,780. Sept. 9, 1960.

A process and device are described for the automatic startup of a nuclear reactor and its automatic control when in full power operation. A measuring head, displaceable along a path in the proximity of the reactor core, measures the neutron flux, and the measuring signal from this head is compared with a reference signal. The difference signal is used to influence the control rods or other means controlling the reactivity, so that during the subcritical state the multiplication factor is increased. During this state, the movement of the measuring head is effected by a servomechanism controlled by the program unit to operate at a higher speed than in the following stage. As the critical state is approached, the speed of this movement is decreased, so that the new speed corresponds to the reactor period desired, until the full operation power is attained. The operation is then continued at a predetermined power level by maintaining the measuring head in a predetermined position. (NPO)

6174 HEADER FOR THE COOLANT OF NUCLEAR REACTORS. (to Commissariat à l'Energie Atomique). French Patent 1,229,865. Sept. 12, 1960.

The header comprises a collar and two plates fixed to this collar and held together by distance pieces. Each of these plates is perforated in alignment with the lattice positions of the reactor for insertion of the reactor tubes enclosing the fuel elements or of other tubes forming the guides for other devices, e.g., for the control rods. The inside of the wall of the header is suitably provided with a thermally insulating layer, while the outside is enclosed by a cooling casing in which an auxiliary coolant flows in order to keep all the parts of the header at essentially the same temperature. The inside of the reactor tubes communicates with the headers suitably by lateral openings in these tubes. Preferably, one header is provided for each front face of the reactor and serves as entrance or exit header. (NPO)

6175 IMPROVEMENTS RELATING TO FLOW CONTROL DEVICES MOUNTED IN THE CHANNELS OF A GAS COOLED NUCLEAR REACTOR. (to Chantiers de l'Atlantique). French Patent 1,230,011. Sept. 13, 1960.

In order to avoid the blowing out of fuel elements during a charging or discharging operation effected during the working of the reactor, flow control devices are provided for each channel to limit the gas flow therein and automatically to keep it constant. Each control device comprises a tubular casing fixed in the lower extremity of the reactor channel and a guiding piece mounted in the axis of this tubular casing. A valve piece is able to slide in axial direction on this guiding piece and tends to be lifted by an increased gas flow in such a way that the down-stream surface of the valve piece approaches the lower part of the inner surface of said tubular casing thus narrowing the opening of this flow control device, so that the flow tends to decrease again. (NPO)

6176 IMPROVEMENT RELATING TO NUCLEAR REACTORS IN PARTICULAR TO HETEROGENEOUS GAS COOLED REACTORS. (to Société d'Exploitation des Matériels Hispano-Suiza). French Patent 1,230,019.

In many gas-cooled reactors, with vertical channels, a charge-discharge machine is provided that can be displaced on a charging floor above the top of the reactor and can be brought into alignment with the different charging holes in this floor. The fuel element removed from such a reactor is stored in an annular rotatable magazine, which is then discharged from the machine together with the fuel elements as a unit. The machine is filled with a gaseous coolant. In order to avoid too high gas losses from the machine during the discharge of the magazine, the space enclosed by the machine is divided into two parts, an upper part enclosing the hoisting and handling means and a lower part enclosing the magazine. These parts can be separated from each other in a gas-tight manner by closure of the dividing element, so that during the discharge of the magazine only the gas enclosed by the lower part of the space is lost. (NPO)

6177 HANDLING SYSTEM FOR MACHINES AND DEVICES FOR THE OPERATION OF A NUCLEAR REACTOR. (to Société Indatom and Compagnie des Ateliers et Forges de la Loire). French Patent 1,230,022. Sept. 13, 1960.

A handling system is described for the operating machines of a nuclear reactor with vertical channels, these machines being horizontally displaceable in an operating space above the reactor. Preferably, above the reactor vessel a shielding plate is situated provided with a number of normally closed openings, each giving access to a number of reactor channels, these openings lying inside an imaginary circle. Above this shielding plate, a support is disposed diametrically over the circle and mounted on wheels traveling on circular rails that are fixed in the floor of the operating space so as to surround the said shielding plate and be concentric with the said circle. This support is provided with further rails enabling the self-propelled operating machines to move in radial directions, so that the lower connection nozzle of each machine may be brought into alignment with the axis of each access opening, in order to be coupled therewith. The rails on the support may be brought into alignment with peripheral rails mounted in radial directions on the floor of the operating space for bringing the machine from the support into position on these peripheral rails. (NPO)

6178 DEVICE FOR PREVENTING THE FORCING OUT OF THE FUEL ELEMENTS OF A HETEROGENEOUS NUCLEAR REACTOR COOLED BY A PRESSURIZED FLUID. (to Société Indatom). French Patent 1,230,023. Sept. 13, 1960.

In a gas-cooled nuclear reactor with vertical fuel element channels and upward circulation of the coolant through these channels, there is a critical coolant flow at which the fuel elements begin to be forced out of the channel. This flow depends on the number of fuel elements situated at any given moment in the channel. In order to ensure that this effect does not arise during the charge or discharge operation of the reactor, a counter flow is passed through the charging tube coupled with the upper end of the fuel element channel in question so that both flows leave the charging tube by lateral openings in its lower end. The flow is thus reduced and depends on the intensity of the counter flow which is controlled in accordance with the number of fuel elements present. This counter flow also serves to cool the fuel elements during their passage out through the charging tube. (NPO)

6179 SYSTEM AND INSTALLATION FOR GAS COOLED NUCLEAR REACTORS FOR CHARGING AND DISCHARGING THE FUEL ELEMENTS. (to Société Indatom and Compagnie des Ateliers et Forges de la Loire). French Patent 1,230,024. Sept. 13, 1960.

The installation comprises two gas-tight containers, one for charging and the other for discharging. These containers may be interconnected via a compressor or like machine so that it is possible to pass a part of the gas from one container to the other, the total quantity of gas in the containers remaining constant. In this manner the pressure in one of the containers may be made equal to the working pressure in the reactor vessel, while the pressure in the other container is reduced to atmospheric pressure, and vice versa. The transfer of a fuel element from or to the reactor vessel is effected when the pressure in the container in question is equal to the working pressure in the reactor, while the fuel element transfer from or to the outside of the reactor is effected when the pressure in the container in question is equal to the atmospheric pressure. (NPO)

6180 CHARGING-DISCHARGING DEVICE FOR THE FUEL ELEMENTS OF A NUCLEAR REACTOR. (to Chantiers de l'Atlantique). French Patent 1,230,538. Sept. 16, 1960.

The nuclear reactor has vertical fuel element channels. The top of the reactor is provided with a plurality of charging holes, in each of which may be mounted the device able to charge or discharge a number of adjacent channels. The device comprises guiding means having the form of a collapsible parallelogram constituted by parts jointed together and is mounted on the lower extremity of a charging chute which is rotatably mounted in the charging hole of the reactor vessel. For charging a fuel element, the device is let down by a cable-supported grip firstly through the charging chute, then along guiding means on the upper sloping part of the parallelogram system, and finally down into the reactor channel. During all these movements the fuel element remains vertical. Preferably, during the movement along the sloping part of the parallelogram system and the charging chute, the fuel element is enclosed in a tubular protecting container having at its upper end laterally mounted rollers that slide in rails provided in the guiding means, viz in the charging chute and the said sloping part of the parallelogram system. (NPO)

6181 IMPROVEMENTS RELATING TO NUCLEAR REACTORS IN PARTICULAR TO HETEROGENEOUS GAS COOLED REACTORS. (to Société d'Exploitation des Matériels Hispano-Suiza). French Patent 1,230,563. Sept. 16, 1960.

For a nuclear reactor with a horizontal charging floor situated above the reactor vessel, annular means are provided for shielding the radioactive fuel elements during the transfer from the charging hole into the charging machine as from the moment that the opening of the latter is brought into alignment with the said charging hole. The charging machine is movable on the rails of a bridge-like carriage, which is able to travel on rails situated on two sides of the charging area. Preferably said annular shielding means are also movable in two horizontal directions by an appropriate carriage system and comprise suitably a lower and an upper part pressed respectively against the charging floor and the lower surface of the charging-machine. The surfaces of these parts have opposing zigzag profiles, which interpenetrate so that there is nowhere a free path for radiation through the interspace bounded by these surfaces. (NPO)

6182 HANDLING CONTAINERS FOR THE FUEL ELEMENTS OF A NUCLEAR REACTOR AND METHOD OF USING THEM. (to Chantiers de l'Atlantique). French Patent 1,230,564. Sept. 16, 1960.

Preferably two identical handling containers are coupled successively with the charge hole in which at a given moment the fuel charging chute system is inserted. The charging system remains in place, while to the hole is coupled first the one charging container for discharging the depleted fuel elements and then the other for charging the new fuel elements. Each container is shielded and comprises a fluid-tight vessel that can be brought into connection with the charging hole, this vessel enclosing a rotatable receptacle with a number of compartments for receiving the fuel elements; each compartment may be brought into alignment with the charging hole. A hoist with a cable-suspended grab is able to transfer the fuel element from this receptacle into the reactor and vice versa. During these operations the fuel elements and the outer surface of said vessel may be gas cooled. An auxiliary coater cooling system is also provided. Preferably, each receptacle is able to accommodate all the fuel elements of a given reactor channel. Each container performs charging and discharging functions alternately in regard to successively serviced reactor channels. (NPO)

6183 PROCESS AND DEVICE ALLOWING THE SERVING, IN COOPERATION WITH SPECIAL MACHINES, OF THE VERTICAL CHANNELS OF A GAS COOLED NUCLEAR REACTOR. (to Chantiers de l'Atlantique). French Patent 1,230,565. Sept. 16, 1960.

In a gas-cooled nuclear reactor having vertical channels, the charging and discharging of the fuel elements is effected through charging holes from a charging floor situated above the pressure vessel, each hole serving a group of reactor channels. The upper shield between the vessel and the charging floor comprises two spaced layers. Each charging hole system comprises a lower tubular casing connected with the reactor vessel and ending with its upper extremity nearly in the middle of the interspace between the said layers, this casing being normally closed by a plug, and an upper tubular casing passing from the said charging floor through the upper shield and reaching to the proximity of the upper end of the lower casing. In each upper casing a tubular element may be inserted, so that it may be coupled in a tight manner firstly at its lower end with the upper extremity of the corresponding lower casing, and secondly at its upper extremity with the upper tubular casing and with the special operating machines effecting the charging or discharging. Preferably, the upper part of each such tubular element comprises a valve, which, when open, allows the passage of the plug closing the lower tubular casing and the introduction of the charging tube system into the reactor vessel. (NPO)

6184 NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,230,954. Sept. 21, 1960.

A storage facility is provided outside the reactor containment in order to store the radioactive fuel elements discharged from a nuclear reactor until their activity has fallen below a given value. This storage facility comprises a shielded cylindrical vessel in which an annular container is placed having several concentric rows of tubular cases for receiving the fuel elements. Each of these cases may be brought into alignment with one of a number of entrance or exit tubes connected to the top of the container. The said entrance tubes are shielded and pass through the reactor containment shell to the reactor charging floor while the exit tubes connect the storage container with a hot cell for the further processing of the fuel elements. (NPO)

6185 IMPROVEMENTS RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. (to C. A. Parsons & Co., Ltd.). French Patent 1,231,675. Sept. 30, 1960.

A fuel element for use in a gas-cooled reactor has a nearly cylindrical shape, its cladding sheet being provided with helically shaped radial cooling ribs. The channels formed between adjacent ribs are intersected by screening plates inserted in slots made in the cooling ribs and extending in the direction of the fuel element axis. These screening plates extend radially outwards further than the cooling ribs and are fixed together by several spacing rings each connecting all these screening plates at a predetermined place along the fuel element axis, these rings engaging with the peripheral edges of the screening plates at slots formed in the inner surfaces of the rings, thus restraining the screening plates against any axial or radial movement. (NPO)

6186 CHARGING TUBE SYSTEM FOR NUCLEAR REACTORS. (to Société Indatom and Compagnie des Ateliers et Forges de la Loire). French Patent 1,232,353. Oct. 7, 1960.

The charging tube system is used for charging a group of vertical channels through a single charging hole in the top of the reactor pressure vessel. The charging hole is provided with a vertical tubular casing which accommodates two concentric tubes that can slide one inside the other in such a manner that each may freely rotate with respect to the other, but both axially movable as a unit. The lower end of the inner tube protrudes from the outer tube and is covered by a tubular piece that is screwed into the end of the outer tube and is fixed to the inner tube in such a way that rotation with respect thereto is not possible but axial sliding is; as a consequence, any relative rotation between the tubes causes an axial displacement of the tubular piece. The inner tube is provided at its lower end with an extension with semi-annular cross section. At the lower end of this extension a lower charging tube is jointed; this is provided at the upper end with a similar extension to that of the said inner tube and has a lower extremity that can be brought in front of each of the exits of the reactor channels of the group. At the lower end of the tubular piece, a linking rod is jointed that has a semi-annular cross section also and is jointed at its lower end to the said lower charging tube in such a way that any axial movement of the tubular piece causes a rotation of the lower tube about its joint. The cross section of the linking rod completes the cross sections of the said two extensions to a whole tube when the lower tube is in a vertical position. (NPO)

6187 DEVICE ENSURING THE TIGHTNESS OF THE CHARGING-DISCHARGING TUBE SYSTEM OF A NUCLEAR REACTOR. (to Société Indatom and Compagnie des Ateliers et Forges de la Loire). French Patent 1,232,354. Oct. 7, 1960.

The heat of the charging tube system is mounted in the tubular casing of the charging hole and is provided with a valve which in its open position affords a passage for the insertion of a closing plug or the jointed charging arm. As the nose of the charging machine enters the upper tubular extension of the said head, this movement controls a slide valve that cuts the rinsing flow of the double gasket seal of the valve and opens the rinsing flow of the similar seal that is established between the said nose and the said head; the space between the valve and the nose is then evacuated and filled with fresh coolant before the valve is opened. The said closing plug or said jointed charging arm is sealed inside the casing of said head by a similar rinsed two gasket seal. (NPO)

6188 DEVICE FOR CHARGING ELEMENTS INTO A NUCLEAR REACTOR, THESE ELEMENTS BEING PROVIDED WITH A CABLE CONNECTION TO THE OUTSIDE OF THE REACTOR. (to Indatom and Compagnie et Ateliers des Forges de la Loire). French Patent 1,232,423. Oct. 7, 1960.

A device is described for suspending a series of fuel elements in the vertical channel of a nuclear reactor and for connecting measuring heads (e.g., thermocouples mounted in the fuel elements) via electric cables with the outside of the reactor. For this purpose, a lifting device is situated in the head of the charging tube system mounted in the charging hole; this device comprises a tubular casing enclosing a winch driven by an electric motor, this winch being attached to and controlling the vertical movement of the movable part of two identical pulley block systems parallelly mounted below the winch on common aces; a counterweight is attached to the lower part. A grab that can couple with a series of fuel elements is suspended below the counterweight by two cables; each cable has a conducting core and passes over one of the pulley block systems and is attached at its other end in the upper part of the casing. The cores emerging at the upper ends of the cables are connected in any suitable manner with the outside of the reactor; at the lower ends the cores pass to the measuring heads of the fuel elements. (NPO)

6189 NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,232,607. Oct. 11, 1960.

A nuclear reactor is described comprising a graphite moderator structure provided with a plurality of parallel channels for accommodating the fuel elements. In order to flatten the temperature distribution and increase the average temperature in the graphite structure, the said channels are each provided with a thermally insulating lining. Preferably this lining is constituted by tubular pieces made from a material having a low neutron absorption cross section and forms with the channel surface an annular interspace filled with stagnant gas, this interspace constituting the principal thermal insulation that almost completely suppresses heat transfer from the moderator system into the cooling gas circulating in the reactor channels. (NPO)

6190 DAMPING DEVICE FOR STOPPING A FALLING BODY. (to C. A. Parsons & Co., Ltd.). French Patent 1,232,989. Oct. 12, 1960.

For stopping a falling body, e.g., a control rod in a nuclear reactor, a damping device is provided to ensure that the essential parts of this body do not become deformed. The kinetic energy of the body is absorbed by the deformation of one or several pieces by accordion-like crumpling up and pleating of these pieces, which are made from sheet material. Preferably, the said pieces are constituted by hollow cones mounted in the device, their axis being in the direction of the stopped movement. At the beginning of the deceleration of the body a spring, suitably mounted between two of the deformation pieces, is totally compressed by the inertia forces before the deforming of said pieces begins. (NPO)

6191 HEAT RECOVERY PROCESS FOR A NUCLEAR REACTOR. (to Commissariat à l'Energie Atomique). French Patent 1,233,085. Oct. 12, 1960.

In order to increase the heat exchange in a nuclear reactor without the necessity of increasing the pressure in this reactor, a liquid, having at the operating pressure a relatively high boiling point, is injected into the reactor channels, so that it circulates in the form of a mist in heat exchange contact with the fuel elements positioned therein. The heat developed in the fuel elements is transmitted to the mist which absorbs it by evaporation. The resulting fluid is conducted to a heat exchanger where it is condensed, and is then fed via a pump to the means enabling the said injection into the fuel channels. The said fluid is suitably constituted by sodium, zinc, magnesium, or sulfur in liquid or vapor state. (NPO)

6192 NEUTRON SHIELDING FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,233,935. Oct. 13, 1960.

In a nuclear reactor having reactor channels in which the fuel elements are located and cooled by a circulating fluid, the front face of the reactor core is covered with a neutron shield placed inside the space bounded by this front face and the pressure vessel wall enclosing the reactor core. This neutron shield has passages in alignment with the reactor channels and each encloses neutron shielding means comprising a plurality of surfaces so arranged as to disperse the neutrons to enable their absorption in the said shield, while allowing the cooling fluid to circulate the said passages without undergoing substantial pressure drop across said neutron shield. Preferably, each of these shielding means comprises a central longitudinal member provided with at least one spiral rib whose edge reaches to the wall of the passage in which these means are placed. (NPO)

6193 NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,233,936. Oct. 13, 1960.

A nuclear reactor with parallel channels is described, each channel being in alignment with its own charging hole in the top shield of the reactor. Each charging hole is normally closed by a shielding plug joined to a series of interconnected fuel elements placed in the usual manner in the core section of the corresponding reactor channel, so that as the plug is withdrawn from its normal position in the charging hole, these fuel elements are also withdrawn from the core. Suitably, for this purpose, the removable cover that normally closes the upper end of the charging hole is replaced by a tubular extension. A fluid operated piston sliding inside this extension is joined at its lower extremity to the plug. When the piston slides upwards by fluid action, the interconnected fuel elements are withdrawn from their position in the core to a position situated between the core and the top shield, so that, e.g., a damaged fuel element is no longer exposed to the influence of the neutron flux in the core, the fuel element remaining in this provisional withdrawn position until a discharge machine is available. (NPO)

6194 IMPROVEMENTS RELATING TO INSTALLATIONS COMPRISING A NUCLEAR REACTOR. (to Babcock & Wilcox Ltd.). French Patent 1,233,964. Oct. 13, 1960.

The boiler of this installation has a steam-generating stage with a separator drum situated outside the boiler casing. The operating fluid from said separator drum is circulated at a variable rate through the economizer in order to adjust the temperature of the coolant entering the reactor, while the liquid space of the drum is fed with operating fluid from a source via the economizer, a variable portion of this latter operating fluid being caused to bypass the economizer. Suitably, the proportion of operating fluid that is diverted through the by-pass increases as the rate at which operating fluid from the separator drum is circulated through the economizer increases. (NPO)

6195 GRAPHITE MODERATED NUCLEAR REACTOR. (to C. A. Parsons & Co., Ltd.). French Patent 1,234,038. Oct. 14, 1960.

By the action of a neutron flux, energy is stored in the graphite moderator structure of a nuclear reactor. In the case of too low a graphite temperature, abrupt releases of this energy occur, which may cause a reactor incident. In order to avoid too low a temperature in the peripheral parts of the moderator structure during the operation of the reactor, the extremities of the inner surfaces of the channels passing through this moderator structure are protected against heat losses. For this purpose, graphite sleeves are inserted in these channel extremities to form with the inner channel surfaces annular interspaces filled with stagnant gas, these interspaces being separated from the cooling gas circulating in said channels. Each of these graphite sleeves is provided at its extremities with peripheral flanges that are in contact with the channel surface and serve for centering the sleeve in the channel. (NPO)

6196 CLOSURE MEANS FOR NUCLEAR REACTOR CHANNELS. (to Commissariat à l'Energie Atomique). French Patent 1,234,173. Oct. 14, 1960.

In order to ensure the shielding of the outlets of the channels passing through the biological shield of the reactor, two cylindrical bodies with equal dimensions are rotatably mounted, end to end in the same axis, in a tubular casing passing through said shield. These cylinders each have a series of longitudinal eccentric channels the axes of which lie in a circularly cylindrical surface. By rotation of the cylinders, these channels may be brought into alignment with each of a series of reactor channels having their axis lying in the same cylindrical surface, in such a way that two aligned channels of the rotatable cylinders may form a charging duct for one reactor channel at a time, the other channels being shielded by the masses of the cylinders. (NPO)

6197 IMPROVEMENTS RELATING TO THE EMBODIMENT OF A NUCLEAR REACTOR. (to Sir Robert Mc.Alpine & Sons Ltd.). French Patent 1,235,225. May 23, 1960.

In the nuclear power plant described, the heat exchangers or boilers are located in a space between primary and secondary biological shielding walls surrounding the closed reactor space. Preferably, the reactor vessel is constituted by a closed inner chamber formed of concrete surrounded by an outer concrete wall positioned so as to afford an annular space which is divided by vertical concrete partitions to form a plurality of closed annular chambers; flow and return passages are provided in the wall between the inner chamber and the annular chambers for the circulation of the reactor coolant between these chambers and inlet and outlet passages are provided in the outer concrete wall for a working fluid which is to receive heat from the coolant. Preferably, the whole concrete structure comprises two vertical concentric cylinders, both based on a single concrete raft, and a concrete roof closes the upper end of the inner cylinder and the upper end of the annular space between the two cylinders, the heat exchangers being placed in said annular space. Suitably, the inner chamber has an apertured concrete floor spaced from said concrete raft and defining with the raft a lower chamber from which the reactor coolant passes through the said apertures into the inner chamber constituting the reactor vessel. This lower chamber is preferably connected by lateral passages with the blowers for the coolant aspirating the coolant from the annular space in which the heat exchangers are situated. (NPO)

6198 IMPROVEMENTS RELATING TO HEAT CARRIER SYSTEMS IN PARTICULAR FOR GAS COOLED REACTORS. (to Commissariat à l'Energie Atomique). French Patent 1,236,090. June 7, 1960.

Improvements are described for heat carrier systems, especially for gas-cooled reactors, comprising a multitude of tubes passing through the core of a nuclear reactor, these tubes being interconnected at their extremities by headers situated outside the core. At least the parts of the tube system where these tubes are connected with the different headers are held at a low temperature by means of internal thermal insulation and external cooling; in this manner different thermal expansions in the tube system are avoided. Preferably, the system is used for nuclear reactors having a liquid, in particular heavy water, as moderator. Suitably, the said heat insulation may be obtained by providing in the tubes a double wall, with an intermediate gas layer at the same pressure as the gaseous heat carrier, the internal wall of the double wall being provided with devices able to absorb expansions. (NPO)

6199 CHARGING AND DISCHARGING DEVICE FOR A NUCLEAR REACTOR AND SIMILAR APPLICATIONS. (to Commissariat à l'Energie Atomique). French Patent 1,236,554. June 13, 1960.

A device is described for charging and discharging the fuel elements placed side by side in vertical position in the core of a nuclear reactor. For these reactors, a rotating shield system is generally situated above the reactor core with at least one charging hole that can be brought into alignment with the axis of each fuel element. In order to avoid taking away adjacent fuel elements when a particular element is being removed, a vertical guide tube is provided having at its ends a flange that retains the adjacent fuel elements. After being coupled with the handling head of the fuel element, a grip is lifted by a cable and a drum drive, the latter being mounted in the shielding plug obturating the charging hole, and brings the fuel element into the guide tube. The shielding plug which supports the guide tube is then removed from the reactor together with the fuel element. The grip comprises a heavy cylindrical clamp support sliding on a central rod to which the lifting cable is fixed. The movement of the clamps is controlled by the movement of said support relative to the rod, the latter movement being induced as the support is coming to rest on the handling head of the element to be removed. (NPO)

6200 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Hawker Siddeley Nuclear Power Co., Ltd.). French Patent 1,237,444. June 20, 1960.

A liquid having a high thermal neutron absorption coefficient is so contained in a reservoir connected to a channel of relatively narrow cross section that a rise in temperature beyond a predetermined level during operation of the reactor causes an increase in the quantity of material in the channel and a resultant increase in the surface to volume ratio of said liquid; this causes an increase in absorption of thermal neutrons and thus a decrease in reactivity of the reactor. According to an embodiment, the neutron-absorbing liquid, e.g. mercury, is contained in a reservoir connected to a capillary tube channel after the fashion of a thermometer. The said channel, which together with the reservoir may be made of stainless steel, is sealed at the end remote from this reservoir. (NPO)

6201 NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,238,675. Nov. 4, 1960.

The axes of the parallel channels of a nuclear reactor are positioned in the surfaces of a number of concentric cylinders, the distance between two adjacent axes in the same cylinder being the same for all the concentric cylinders. Preferably, the distance between adjacent cylindrical surfaces does not change. According to another embodiment, the distance between adjacent surfaces decreases progressively with increasing cylinder diameter. Suitably, the headers for the coolant have an annular shape and are arranged one after the other in such a way that in vertical section the centers of their cross sections lie on a curve whose slope always has the same sign. (NPO)

6202 IMPROVEMENTS RELATING TO FUEL ELEMENT CHARGING DEVICES FOR NUCLEAR REACTORS. (to Société Fives Lille-Cail). French Patent 1,239,361. July 18, 1960.

A grip able to be let down into a reactor channel in order to couple with the handling head of a fuel element is controlled by fluid pressure. The grip is suspended on a hollow cable and moved by a drum drive via this cable. If the operator notices an untimely arrest of the movement of the grip, he can admit a fluid pressure to the grip via the hollow cable and thus cause at least one piston-controlled clamp to protrude and immobilize the grip in the channel. When the said pistons are in the fully advanced position, each of them frees the passage for the pressure fluid to a hydraulic jack that pushes down the lower part of the grip system in order to force a passage through the channel. (NPO)

6203 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). French Patent 1,240,419. July 25, 1960.

For the fast shutdown of a nuclear reactor, an apparatus is provided able to cause neutron absorbing balls to fall into the core space of a nuclear reactor and able then to recover these balls. Preferably, this apparatus comprises an upper vertical tube reaching down from the upper shield at the top of the reactor to a point near the top of the reactor core and a lower tubular container closed at the bottom and able to slide with a flange at its upper end inside the former tube. In its lowest position, the container tube is situated inside the core and in case of danger may receive the balls from a feeding box positioned at the upper end of the vertical tube. The release of the balls from the box is effected by appropriate valve means. At the bottom of the tubular container one end of a chain is fixed; this chain may be wound up by a pulley situated alongside the said feeding box in order to lift the container tube into an upper position out of the reactor core. When the container is in this position, the balls are blown back into the feeding box by pneumatic means. (NPO)

6204 LIFTING GRIP FOR THE FUEL ELEMENTS OF A NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,240,960. Aug. 1, 1960.

The lifting grip can be let down into a reactor channel in order to be coupled with the handling head of the fuel element to be removed. The said grip comprises a cylindrically shaped case which may slide on a hollow piston between an upper and a lower position. A flexible tube supporting the grip is fixed on the piston and may be wound up by an appropriate drum. The inside of the flexible tube is in communication with the volume enclosed by both the cylinder and the piston, this volume being communication, via a narrow opening in the piston, with the space of the reactor channel, in which steam circulates. For opening the grip, the cylinder is moved against the action of a spring into the upper position by evacuation of the steam in the cylinder by bringing the cylinder volume into communication with a condenser via the flexible supporting tube, the movement of the cylinder controlling the movement of the clamps of the grip. For closing the clamps the communication to the condenser is shut off, so that after a time the steam pressure in the cylinder increases as a result of slow leakage from the reactor channel via the opening in the piston, and the cylinder is restored to the lower position by the action of said spring. For indication whether the jaws of the grip are open or closed, steam-operated signal means are provided. (NPO)

6205 LIFTING DEVICE FOR THE ELEMENTS OF A NUCLEAR REACTOR. (to Plessey Co., Ltd.). French Patent 1,241,050. Aug. 1, 1960.

The device can be let down into a reactor channel and be coupled with the handling head of the element to be lifted. The lifting device has at its lower end a grip comprising an outer case in which a central piece with a preferably cone-shaped lower nose may slide. The lower part of the inner wall of said case and the surface of the central piece define an annular interspace, the said surfaces of the case and piece being each provided with an annular groove at nearly the same level. A number of clamps are provided, each of which bears two lateral protuberances at its upper end, which protuberances engage respectively with the two grooves in such a way that an axial movement of the central piece relative to the case, produces a turning movement of the clamps. The lower ends of the clamps are hook-shaped and lock the handling head of the element after they have been turned toward the axis of the grip, the conical nose coming to rest in a corresponding conical hole in the handling head. The central piece may be locked by appropriate means against movement relative to the case. (NPO)

6206 ELECTRO-HYDRAULIC CONTROL DEVICE FOR THE CONTROL ORGANS OF NUCLEAR REACTORS. (to Siemens-Schuckertwerke A. G.). French Patent 1,244,585. Sept. 19, 1960.

The advantages of hydraulically controlled rod drives and of the "Magnetic Jack" drives are united in a device comprising a piston that is connected at one side with the control rod and at the other side with the bar bundle of a "Magnetic Jack" drive. This piston slides inside a cylinder reaching into the reactor, the axis of this cylinder being alignment with the axis of a reactor channel. The part of the cylinder that is always separated by the piston from the reactor core is put into communication with a low-pressure part of the cooling circuit of the reactor or with a high-pressure part thereof in order to move the piston respectively in the two possible directions. Suitably, the communication is effected by a remotely controlled two-way valve. The "Magnetic Jack" device serves only for holding the rods in position and for controlling the speed of their displacement; this is effected by feeding the coil of the "Magnetic Jack" with electric current impulses. (NPO)

6207 METHOD AND DEVICE FOR CONTROLLING THE POWER OF A BOILING WATER REACTOR. (to Société Indatom). French Patent 1,249,290. Nov. 21, 1960.

The position of the control rod of a boiling water reactor is directly influenced by the steam pressure in the reactor vessel in such a way that the difference between the desired working pressure and the real working pressure in the reactor vessel acts in the direction of a diminution of this difference. Preferably, a piston sliding in a cylinder is connected with the control rod, the two said pressures acting on the different faces of the piston in such a way that the control rod tends to enter more deeply into the core as the real steam pressure begins to exceed the controlled pressure. Values representing the differential coefficient of the neutronic power and the differential coefficient of its logarithm are derived by appropriate means; these values influence the said controlled pressure in a negative feed back manner. (NPO)

6208 NUCLEAR REACTOR. (to Aktiebolaget Atomenergi). French Patent 1,251,708. Dec. 12, 1960.

A boiling water reactor is described in which heavy water is used both as moderator and as coolant. In order to make the reactor self-regulating and to provide a reactor core system across which only a small pressure drop is set up, the fuel elements immersed in the heavy water are distributed over the core space in such a manner that individual fuel zones alternate with moderator zones, so that the heavy water passing through a predetermined fuel zone comes into a zone occupied only by heavy water, and the developed steam bubbles become dispersed in this zone during their passage through it. In this manner, only a small part of the steam bubbles enters the succeeding fuel zone, so that all the fuel elements are in good contact with the liquid phase. Suitably, each fuel zone is occupied by a fuel element assembly comprising a number of ball-shaped fuel elements, these balls being freely disposed in a perforated supporting box. According to another embodiment, the said fuel element assemblies are each composed of a plurality of fuel rods assembled at their extremities, succeeding elements constituting the links of a chain. For dispersing the steam bubbles, a baffle plate is provided between two adjacent links. (NPO)

6209 BOILING WATER REACTOR. (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). French Patent 1,257,368. Feb. 20, 1961.

Boiling water reactors are described whose fuel elements each have two different kinds of surfaces, the surfaces of the first kind being in contact with the boiling water. The steam developed is allowed to pass over the surfaces of the second kind where it is superheated. Suitably, the fuel elements each have a tubular shape and are immersed in the water to be boiled; some of the tubular fuel elements may be open at their upper extremities, which latter extend into the space above the surface of the boiling liquid so that the steam that accumulates in this space passes down through these tubular fuel elements for superheating. This partially superheated steam then suitably rises through another adjacent fuel element for final superheating, the upper extremities of the latter being connected to a steam-header, situated above the level of the boiling liquid, for collecting the superheated steam. (NPO)

Power Reactors

Refer also to abstract 5462

6210 (APAE-Memo-298) FAILURE ANALYSIS OF DISPERSION FUEL ELEMENTS BASED ON MATRIX CRACKING. S. D. Beck (Alco Products, Inc., Schenectady, N. Y.). Dec. 28, 1961. Contract AT(30-1)-2639. 45p.

A mathematical model has been developed for estimating the burnup at which mechanical failure occurs in dispersion fuel elements. It is postulated that failure at low temperature, < 900°F, occurs as a result of brittle fracture of an elastic matrix when the intensity of the stress locally reaches the ultimate strength of the material. The contributions of fission gas pressure and thermal stress are incorporated in the stress analysis. Because of the complexity of the stress distribution and the failure process, it was necessary to make stringent assumptions in order to have a workable model. Within the framework of the postulates, burnups to failure are predicted for several values of certain important parameters and compared with burnups to failure obtained from a plastic yield model for failure developed by previous investigation. The two models give good agreement for the special cases considered. Of the parameters examined, relative density of the fuel particles has the greatest influence on predictions of allowable burnup. The thermal stress and volume fraction of fuel play minor roles. (auth)

6211 (BW-AED-501) LIQUID METAL FUEL REACTOR. Interim Feasibility Report. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Mar. 31, 1955. For Brookhaven National Lab., Upton, N. Y. Contract AT-30-2-GEN-16, Subcontract S-262. 358p.

An evaluation was made of the design concept of the Liquid Metal Fuel Reactor (LMFR). Drawings and specifications covering a preliminary design for a full-scale, practical LMFR system including the general arrangement of the reactor vessel, heat exchangers, pumps, pipings, and process plants are given. It was concluded that there are no critical items which require development work before a LMFR experiment is justified. The research and development work required before a full-scale plant is undertaken is discussed. Topics covered include chemistry and chemical engineering, metallurgy and materials, nuclear physics, mechanical design, general description of reactor, steam generation and chemical process systems, components design, and economic potentials. (M.C.G.)

6212 (GA-1532) MARITIME GAS-COOLED REACTOR PROGRAM. Quarterly Progress Report for Period Ending June 30, 1960. (General Atomic Div., General Dynamics Corp., San Diego, Calif. and General Dynamics Corp. Electric Boat Div., Groton, Conn.). Contract AT (04-3)-187. 146p.

The first semi-homogeneous fuel element model was removed from the Hanford in-pile loop after approximately 1000 hrs irradiation. Examination indicated no dimensional changes or discoloration of the model. Some minute cracks were located in the cladding. The fission products which were detected in the loop during irradiation are attributed to these cracks. Design of the reactor vessel is continuing. More detailed calculations of fuel element performance are being carried out using computer codes to determine the effect of different flux distributions. Calculations are also under way to determine the effect on fuel element temperature of perturbations on coolant flow. Work is under way to establish means of analyzing and predicting details of the heat transfer process in fuel elements. This includes measurement of flow and pressure profiles in large scale models and heat and mass-transfer experiments. Burst tests of $^{3}/_{8}$-in. dia, 0.010-in. thick wall Inconel and Hastelloy X fuel cladding tubes indicated bursting pressures greater than 300 psi at 1900°F. Detail design of the reactor core is continuing. Temperature in the moderator is being calculated as a function of variation in coolant bleed flow. Stresses in the core support grid are being analyzed by machine computation. Detail design of the control rod drive mechanism is essentially complete. Tests were started with a ball-nut lead screw running unlubricated in hot helium. No significant wear of the ball-nut device appeared after 5000 cycles at 300°F. Work is continuing on heat transfer tests for the propulsion plant heat exchangers. It was determined that the heat exchanger tubes can be placed on a closer pitch which will enable the heat exchangers to be made smaller. Power plant kinetics calculations included the effect of lead variations on turbomachine speeds. Step changes in auxiliary power from zero to full power or vice versa produce changes of approximately 1 per cent in turbine-compressor speed. The low-pressure turbine bypass control permits output power to vary from zero to full power within five seconds. Power control by bypassing to the regenerator rather than a heat dump was found to be practical. Assembly of the full size bearing and seal test rig was completed. Conceptual design of the sealing and lubrication system was completed and is ready for development testing in the full size test rig. Thermodynamic cycle calculations continued with studies of operation at 1500°F. The 1300°F cycle machinery can be operated at 1500°F without over-speeding by reblading the high-pressure turbine and increasing the cooling bleed flow. Compressor model tests were continued to evaluate the effect of Reynold's number on stage performance. The expected effect did not occur and efforts are being made to refine the loop instrumentation to permit more accurate measurements. The MGCR critical facility was completed and fuel loading begun. Initial power is limited to one watt. Later operation will be at powers up to 500 watts. Experiments are being carried out in the LRL "Hot Box" facility to evaluate the resonance absorption of neutrons in U^{238} at MGCR temperatures. A series of experiments to determine neutron thermalization and Fermi age in beryllium oxide was run in the linear accelerator. An important preliminary result of these experiments is that the Fermi age in BeO is significantly less than that calculated from the age of beryllium. Reactor nuclear calculations were completed for the preliminary design of the Beryllia Reactor Experiment (BRE). The number of fuel elements, fuel loading, and flux distribution for four alternate configurations was determined. The effect of water flooding on reactivity and the necessary control rod worths was calculated. Nuclear calculations for the MGCR prototype consisted of studies of fuel programs to obtain better fuel economy. It was determined that a 3-zone loading program could approach the conditions of uniform burnup, but this resulted in a fuel cycle cost reduction of only 6% compared to single batch loading. Calculations of the prototype reactor temperature coefficient of reactivity indicate a prompt negative coefficient at fuel temperatures to 2000°F throughout the core life. There is a delayed positive coefficient at the end of life due to buildup of Pu^{239}. An irradiation capsule containing composite fuel bodies of UO_2-BeO, UC-graphite, and UC_2-graphite was discharged from MTR after exposure to 45000 MWD/T burnup. There was no detectable change in dimensions. In the preparation of fuel bodies for experiments it was found that the addition of 1.5 wt % calcium oxide to UO_2-BeO bodies resulted in consistently high densities. Creep rupture testing of structural materials under MGCR environment is continuing. Results to date indicate no significant affect of a helium atmosphere on the properties of Inco 713C, SA302B, or type 316 stainless. Niobium-base alloys, of interest as fuel cladding materials, are hardened by oxygen and nitrogen impurities in helium. The first series of tests to determine the self-welding of different metal pairs in helium was completed. (auth)

6213 (GA-1738) MARITIME GAS-COOLED REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING, SEPTEMBER 30, 1960. (General Atomic Div., General Dynamics Corp., San Diego, Calif. and General Dynamics Corp. Electric Boat Div., Groton, Conn.). Contract AT(04-3)-187. 117p.

The feasibility was studied and a cost estimate prepared of an experimental reactor to determine the operating characteristics of beryllia-moderated, gas-cooled systems within a power limit of 10 Mw(t). The heat energy produced by the experimental reactor is to be dissipated in a heat dump. No machinery for production of power was to be provided. Other requirements were that the reactor should be capable of testing core types different from the current MGCR design, and the system should permit use of gases other than helium. It was further directed that the reactor should be designated BORE for Beryllium-Oxide Reactor Experiment. Reactor development work was mainly in connection with the BORE preliminary design. It was established that the most important information which could be provided by a 10 Mw(t) reactor experiment would be on performance of fuel elements and moderator bodies. This required that the experiment duplicate the power density in the fuel and moderator that would exist in the full size reactor and made it advisable to use full length fuel elements. This resulted in an unconventionally shaped core which is roughly cylindrical with the length more than twice its mean diameter. Studies continued on performance of fuel elements, and methods were developed for calculation of thermal stress in BeO-moderated modules. These studies are equally applicable to the MGCR prototype and BORE. A thermal analysis of the MGCR pressure vessel and thermal shields was performed and means of externally cooling the vessel were studied. Some of the components of the experimental control rod drive mechanism were received. Endurance tests of a ball-nut lead screw in hot helium continued. Heat exchanger tests were resumed after an interruption due to leaks in the tube to tube-sheet joints in the test unit. Plant control studies were continued with analyses of the system dynamics with a turbomachinery configuration in which the high pressure turbine provides the output power. This arrangement was found to be more sensitive than the low-pressure drive system. Turbomachinery component tests are providing stage performance data. The seal and bearing test rig was completed and tests were begun. Physics calculations were made for the BORE design. Basic physics information on Fermi age and neutron thermalization in BeO was provided during the quarter by experiments in the linear accelerator. Materials work continued with further investigations of the effect of additives on properties of UO_2-BeO diluted fuel bodies. Hot cell examination of the MTR-31-3 fuel capsule indicated no significant dimensional changes after burnups from 30,000 to 45,000 Mwd/T. An experiment to determine irradiation effects on BeO was inserted in GETR during September. Work was started on development of high density BeO bodies. Structural materials research continued with completion of a second series of self-welding tests of different metal pairs in high temperature helium. A series of galling tests and a series of creep rupture tests of weld specimens in SA302-B steel were completed. Work on site development included establishing requirements of the BORE for buildings, auxiliary facilities, and utilities. (auth)

6214 (GA-2289) THE DEVELOPMENT AND EVALUATION OF GRAPHITE-MATRIX FUEL COMPACTS FOR THE HTGR. Walter V. Goeddel (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 8, 1961. Contract AT(04-3)-314. 103p.

A summary of development and evaluation of graphite-matrix fuel compacts for the high-temperature gas-cooled reactor is presented. The fuel compacts consist of Th–U dicarbide particles dispersed in a high-density graphite matrix and are produced by a hot-pressing process. Compacts prepared from Th–U oxide, Th–U silicide, and Th–U dicarbide coated with pyrolytic C were subjected to radiation and fission-product-retention testing. Results of these tests are included and are discussed in detail. (J.R.D.)

6215 (GAMD-231) POSSIBLE EFFECTS OF GASEOUS IMPURITIES ON OPERATION OF THE HOMOGENEOUS POWER REACTOR. A. W. Searcy (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 17, 1957. Contract [AT(04-3)-314]. 13p.

The possibility of thermal transport of carbon by the reaction $C(S) + CO_2 \rightarrow 2CO$ was considered for the homogeneous power reactor. It was decided that the maximum allowable alteration in surface thickness is 0.2 cm in 6 years. The gas pressures which would give approximately this change in surface area were calculated. The calculated maximum concentrations of various common gases that could cause the hypothesized rate of attack are given. It was concluded that with a 1000°K minimum temperature of operation, a reactor that employs $UO_2 + C$ will probably have significant thermal transport of carbon if operated at an upper temperature above 1500 ± 200°K unless canning or coating techniques are used to prevent CO from entering the helium stream. (M.C.G.)

6216 (GAMD-1330) CORROSION OF STAINLESS STEEL BY IODINE VAPOR IN THE HTGR FISSION PRODUCT PURGE SYSTEM. R. M. Watkins (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Apr. 29, 1960. Contract AT(04-3)-314. 14p.

The possibility of corrosion damage to stainless steel tubes by iodine vapor, which will be a major fission product expected in the gas stream in the HTGR fission product purge system, is evaluated. Experiments showed that corrosion of stainless steel by iodine vapor should not result in significant damage if the moisture content of the gas stream is maintained below 10 ppm. The corrosion damage reported, which results from exposure of stainless steel to moist iodine vapor, appears to be significantly reduced by lowering the water vapor content of the corroding atmosphere. (P.C.H.)

6217 (GEAP-3835) FUEL CYCLE PROGRAM. A BOILING WATER REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Report No. 5, July 1961–September 1961. J. A. Hodde, ed. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Oct. 10, 1961. Contract AT(04-3)-189. 31p.

Advanced Fuel Power-Limit Test. Fabrication of the 50 basic fuel assemblies has been completed. The three instrumented fuel assemblies were assembled and calibrated. Equipment and procedures have been prepared for the VBWR stability tests. Forty-two assemblies were irradiated during the last VBWR run. Average exposure for all assemblies which have been irradiated are tabulated. Detailed examination of the centermelt calibration assembly is in progress. Preliminary metallography indicates that centermelting did not occur. The conductivity of UO_2 is appreciably higher than the design basis of 1.1 Btu/hr-ft^2 (°F/ft). This result indicates that the fuel performance limit is higher than the burnout heat flux limit. Heat Transfer and Fluid Dynamics. Use of a "rough" liner in the single rod test section resulted in a 10 to 43% increase in burnout heat flux at various operating conditions. The high-speed movies of the high pressure observational boiling experiments have been edited and assembled. Analytic work is being continued. A theoretical analysis of two-phase pressure drop and density distribution has been made. Experimental Physics. Isotopic analyses of unirradiated fuel pellets show good uniformity. Preliminary calculations of expected isotopic compositions during irradiation are being made. (auth)

6218 (GNEC-93) GAS-COOLED REACTOR PROJECT PROGRESS REPORT NO. 4. (General Nuclear Engineering Corp., Dunedin, Fla.). Apr. 15, 1959. For East Central Nuclear Group and Florida West Coast Nuclear Group, Inc., St. Petersburg, Fla. Contract [AT(38-1)-143]. 112p.

The conceptual design and analysis was directed towards formulating a reference design for both the plant and the enclosure. Preliminary safeguards evaluations indicated that a leak-tight enclosure under accident conditions is required. Building dimensions were established for the concept of a bottom fuel handling machine and its auxiliaries. Design work on the control rod drives is being concentrated on a single concept. Transient studies of the effects of a sudden reactivity insertion continued to show good safety performance of the reactor. Four full-sized pressure tubes were delivered. The first short term tests were run in the corrosion loops at temperatures up to 1500°F. Shakedown tests were run on the heat transfer loop using a single rod heater. A part of the equipment and materials for testing of the plenum box and transition seal was received. (auth)

6219 (GNEC-126) GAS-COOLED REACTOR PROJECT PROGRESS REPORT NO. 6. (General Nuclear Engineering Corp., Dunedin, Fla.). Mar. 15, 1960. For East Central Nuclear Group and Florida West Coast Nuclear Group, Inc., St. Petersburg, Fla. Contract [AT(38-1)-143]. 159p.

A number of modifications and refinements to the reference design was made. These include the following: (1) the pressure tube insulation assembly was changed to incorporate a metallic, rather than ceramic, flow liner. This resulted in a slight reduction of pressure tube diameter and wall thickness; (2) the number of control rods was increased to 33 to permit better distribution of the rods in the core zone; and (3) the air gap between the reactor vessel and the outer thermal shield was increased to provide adequate space for reactor piping. Additional corrosion test loops were placed in service and new materials included in the test program. Among the new materials were Zr alloys now under consideration as flow liners. After nearly 7000 hours in the corrosion test loop, type 347 stainless steel showed promise of being a satisfactory clad material. Investigation of the Fe–Al–Cr alloys as possible clad materials was continued. Work was continued on fabricating Zircaloy-2 to stainless steel joints, the nozzle closure program, stress analysis of plenum boxes, and pressure tube rupture tests. Conceptual design of a 300 Mw(e) reactor was initiated. (W.D.M.)

6220 (LA-2644) MOBILE FUEL PLUTONIUM BREEDERS. A Study of Economic Potential. R. Philip Hammond, Russell E. L. Stanford, and J. Ross Humphreys, Jr. (Los Alamos Scientific Lab., N. Mex.). Nov. 30, 1961. Contract W-7405-Eng-36. 78p.

In the Direct Contact Reactor concept, molten plutonium fuel is circulated and cooled by contact with an immiscible coolant. As an example of a mobile fuel system with a closed fuel-blanket processing loop, the DCR is compared in its economic potential with an advanced solid fuel breeder. The study shows a saving in fueling cost using mobile fuel which is substantially greater than the added investment and operating cost. (auth)

6221 (SRO-61) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, NOVEMBER 1961. (Savannah River Operations Office, AEC). 15p.

Power reactor development activities are reported. Topics covered include the AEC/AECL cooperative program, physics, engineering, metallurgy, materials testing, reactor evaluation, cost optimization studies, Heavy Water Components Test Reactor, Florida Power Reactor, and Parr Shoals Power Reactor. (M.C.G.)

6222 (TID-14419) MONTHLY OPERATING REPORT, OCTOBER 1961. VOLUME IV, ISSUE 10. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 74p.

The refueling program was successfully completed on October 6 with the installation of the reactor chamber dome, and the reactor achieved criticality with Core I, Seed 3 on October 7, 1961. On October 23, with all four reactor coolant loops in service, the generator was synchronized with the Duquesne Light Company System and Seed 3 electrical power output was begun. Several hours later it was found necessary to shutdown due to nuclear instrumentation troubles. Following a 12-hr shutdown, during which the Channel C compensated ion chamber was replaced, the station was returned to service. Seven incidents which occurred during the month are described. The modification, repair, and overhaul of vital equipment was accelerated so that it could be completed in time for power operation. The tests carried out and their results are reported. Significant radiation exposures were received only by those painting the newly installed platforms and container bottoms. (M.C.G.)

6223 (WAPD-MRP-94) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, August 24, 1961–October 23, 1961. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT(11-1)-Gen-14. 143p.

The thermal performance of the PWR-2 was re-evaluated based on the latest nuclear and thermal information, design changes, and the use of the XITE code. The seed cluster design was re-examined both analytically and experimentally from the standpoint of fuel plate stability, and a revised design was submitted for approval. Preliminary depletion studies established a Seed 2 fuel loading necessary to achieve 20,000 EFPH. The most highly depleted rod from the PWR-1 blanket was examined after two seed lives exposure. The initial approach to criticality on PWR-1 Seed 3 was successfully conducted on October 7, 1961. Analysis of fission gas release from swelled compartments of 25 ZrO_2 + UO_2 fuel plates showed that the gas release increases with increasing burnup and/or time in-pile. A calculation was performed of the thermal spectrum in the PWR-2 self-shielded boron by means of a multigroup thermal Monte Carlo program, MARC. A measurement was made of a PWR-2 mock-up containing poison elements which meet the PWR-2 design specifications. The concept of the Safety Injection System was modified to utilize the pressurizer relief valves to reduce primary plant pressure during a loss of coolant accident involving small breaks. The a-c type static inverter development unit was approved as the reference design for the PWR-2 rod control system. Preliminary radiochemical data obtained at initial criticality for Seed 3 indicated that the new seed does not contain excessive uranium surface contamination. (M.C.G.)

6224 (WAPD-T-1318) THERMAL AND HYDRAULIC OPERATING PERFORMANCE OF THE SHIPPINGPORT PRESSURIZED WATER REACTOR, PREDICTIONS VERSUS MEASUREMENTS. P. A. Bickel, and W. J. Gallagher (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Oct. 1961. Contract AT(11-1)-Gen-14. 25p.

Presented at ANS Meeting, November 1961.

Experimental information from operation of PWR Core 1 with the second seed installed is discussed. Three areas of interest are included in which pre-operation predictions were available for comparison: inlet plenum mixing, seed blanket power shavings, and fuel plate centerline temperatures. A tabulation of the mechanical and hydraulic characteristics of Core 1, Seed 2 is included. (M.C.G.)

6225 (WAPD-T-1378(Rev.1)) PWR CORE 2 REACTOR AND ANALYTIC MODEL DESCRIPTION. PART I. M. R. Stuart and R. T. Bayard (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 26, 1961. Contract AT(11-1)-Gen-14. 8p.

Presented at ANS Meeting, Chicago, Nov. 1961.

The second generation seed-blanket reactor designed for installation in the Shippingport Atomic Power Station is described. The power rating of the core was increased from that of Core 1 so that the gross electrical output would equal 150 Mw(e) as compared to 68 Mw(e) for Core 1. The seed was designed so that a reactivity lifetime of 10,000 effective fuel power hours would be achieved. The physical arrangement of Core 2 is shown. The blanket cluster and one quarter of the seed cluster are shown in cross section. The seed consists of 20 clusters, each containing enriched uranium fuel and a control rod channel. The blanket region is made up of 77 clusters of natural uranium fuel. (M.C.G.)

6226 (WAPD-T-1387(Rev.1)) PWR-2 DEPLETION STUDIES. C. A. Flanagan and G. E. Pence (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1961. Contract AT(11-1)-Gen-14. 10p.

Presented at ANS Meeting, Chicago, Nov. 1961.

Use of a synthesis depletion technique has provided estimates of the lifetime behavior of the three-dimensional nuclear characteristics of PWR-2. Both the radial and axial portions of this technique indicate core lifetimes of the order of 10,000 EFPH. A substantial amount of core power is derived from the natural UO_2 in the blanket, amounting to an average of ~47% over core lifetime. Of this amount, a significant portion at end of life is produced by the plutonium isotopes, amounting to ~30% of total core power. Throughout most of core life the limiting three-dimensional power densities do not exceed 2.7 times the seed average. Of the initial seed loading of 236 kg of U-235, 138 kg of U-235 are depleted to achieve core life. (auth)

6227 (XDC-58-4-64) THE TEMPERATURE EFFECT OF ANP REACTORS. R. E. Reid and J. R. Terrall (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 25, 1957. Decl. June 9, 1961. 24p.

The theory and present methods of calculating the temperature effect of ANP reactors are reviewed. Future refinements and experimental verification of these methods are then discussed. (auth)

6228 (CEA-tr-X-422) PROBLEMES DE LA TECHNIQUE THERMIQUE LORS DE LA CONSTRUCTION DE CENTRALES NUCLEAIRES. (Problems of Thermal Techniques at the Time of Construction of Nuclear Power Stations). J. Drasky. Translated into French from Jaderná energie, 5: 362-6(1959). 25p.

After a general introduction on the engineering problems of nuclear power plants, an analysis is given of the technical problems connected with fuel elements, the active zone, and the thermal circuit of a power plant having a heavy-water gas-cooled reactor. (tr-auth)

6229 PROJECT FOR A RESEARCH SHIP WITH AN ORGANIC MODERATED REACTOR (OMSR). I. Weisbrodt (INTERATOM, Cologne) and W. Wiebe. Atomwirtschaft, 6: 441-6(Sept. 1961). (In German)

The first development of a nuclear powered merchant ship in Europe is the project undertaken in Germany for a research ship with an organic moderated reactor having a capacity of 33 to 35 Mwt corresponding to a drive power of 10,000 to 11,000 Shp. A description is given of the present state of the project now that the ship type and size have been fixed and the provisional safety report for the reactor completed. (auth)

6230 HIGH TEMPERATURE REACTORS FOR MARINE PROPULSION. Engineer, 212: 917-22(Dec. 1, 1961).

The design philosophy, cermet tube design, and advanced designs of small marine reactors (20,000 shp) are studied on the two premises that inherent safety is necessary for the reduction of capital cost to an acceptable level and that plutonium from the civil power stations will be the preferred fuel. The need for safety has led to the adoption of a gas-cooled, solid-moderated system in which the fuel elements of about ½-in. diameter are distributed uniformly throughout the moderator. For the small size reactor which can be accommodated in a ship, this design requires a highly enriched fuel. Designs are proposed which use readily available materials and do not require technological developments. Graphite is therefore chosen for use as the moderator, and steel cladding of the fuel elements is adopted in order to restrict the release of fission products into the coolant circuit. Carbon dioxide is the preferred coolant since it is readily available, and its only major defect is its oxidizing nature. With these materials the maximum operating temperature of the moderator is limited to about 400°C, from safety considerations, and that of the fuel to about 750°C. (N.W.R.)

6231 ELECTRICAL ASPECTS OF HUNTERSTON NUCLEAR GENERATING STATION. Engineer, 212: 997-1001(Dec. 15, 1961).

A survey is made of the over-all station control system and the auxiliary supply system with special reference to the arrangements for essential supplies. A detailed description is given of the start-up procedure and operation of the station. No information is presented on reactor instrumentation and control equipment. (N.W.R.)

6232 SITING OF POWER REACTORS IN THE U. K. A. Quinton. Nuclear Energy, 374-7(Sept. 1961).

Power reactors in the United Kingdom are sited with respect to the safety to the population and the environment. Elements determining the safety aspects are reactor size, experimentation involved, meteorological aspects, population density, topographical conditions, reactor types, and safety equipment and precautions used. (N.W.R.)

6233 NUCLEAR POWER, TODAY AND TOMORROW. Kenneth Jay. London, Methuen & Co. Ltd., 1961. 275p. 25s.

A comprehensive account is given of the nature of nuclear power and of the major problems which have to be overcome in making practical use of it. The subject is developed in simple language, beginning with the underlying scientific ideas of energy and of nuclear structure and proceeding through general discussions of nuclear fuels and the economics of nuclear power stations to considerations of particular reactor systems. Information is given on the several gas-cooled graphite-moderated systems now under development in the United Kingdom and the water-moderated systems which are receiving particular attention in the U. S. A. Fast reactors, liquid-fueled reactors, the sodium-graphite system, nuclear propulsion, heat for industry, and the research and development required to bring a particular reactor from conception to full-scale operation are also considered. (N.W.R.)

6234 NUCLEAR SUPERHEATER FOR BOILING WATER REACTOR. Australian Patent 233,492. May 18, 1961.

The reactor comprises an enclosed pressure vessel having two distinct operative regions, one being a boiling region and the other being a superheating region with nuclear fuel elements disposed in each region for heating by a fission reaction in each region. A liquid moderator is maintained in the vessel at a predetermined level to generate vapor in the boiling region and produce superheated vapor in the superheating region in a continuous path. The liquid moderator is force-circulated through the boiling region in parallel to and counter to the flow of vapor through the superheating region. The boiling region is arranged adjacent the peripheral wall of the vessel and the superheating region is arranged in the center of the vessel.

6235 IMPROVEMENTS RELATING TO GAS TURBINE POWER PLANTS. (to Parsons and Marine Engineering Research and Development Assn.). French Patent 1,229,729. Sept. 9, 1960.

A closed cycle gas turbine power plant is described in which changes of load affect only the output turbine and do not affect the other rotating members of the plant. This plant may be, e.g., a nuclear power plant in which the heat output of the reactor is held constant for all turbine outputs from zero to full power. Suitably, the embodiment encloses a primary gas circuit for reactor cooling transferring the heat via a heat exchanger to a secondary working circuit enclosing among other things the said output turbine. This output turbine is provided with a by-pass duct in which the by-passed gas is cooled by an auxiliary heat exchanger, a valve controlling the passage of fluid through this by-pass duct. A branch in said by-pass duct by-passes the said auxiliary heat exchanger, while a valve within said branch controls the passage of fluid through it. The point of entry of said by-pass duct into an outlet duct of the output turbine is situated upstream of a throttle valve provided in this outlet duct, while the point of entry of said branch into said outlet duct is situated downstream of the throttle valve. These valves control the flows in the by-pass and in its branch in such a manner that both the pressure and the temperature in the end of the outlet duct are held constant. (NPO)

6236 METHOD FOR VARYING THE POWER OF A NUCLEAR POWER PLANT. (to Sulzer Frères). French Patent 1,230,196. Sept. 14, 1960.

A regulating process is described for varying the power of a nuclear power plant that has several blowers for the cooling gas, these blowers working in parallel. Any important power increase is effected by starting one or more blowers and connecting them into the cooling system, while any important decrease in power demand is followed by the disconnection of one or more blowers from the system and the stopping thereof. The valve connecting the high-pressure side of the blower with the cooling system is opened while the blower is still picking up speed and before it has reached a working pressure sufficient for positive discharge of gas into the system. After this, the working pressure of the blower is increased up to the working pressure of the other blowers. In the case of decrease of the power demand, the different operating steps are performed in the opposite sequence viz, the valve is closed after the blower pressure has fallen to a value insufficient for positive discharge into the system. (NPO)

6237 NUCLEAR STEAM GENERATOR FOR POWER PLANT. (to Winnett Boyd Ltd.). French Patent 1,234,543. Oct. 18, 1960.

In order to avoid the necessity of using expansion joints, e.g., bellows units, in the gas ducts of a nuclear reactor, the pressure vessel, the gas ducts, the heat exchangers, and the blowers for circulating the gaseous coolant are surrounded by a liquid coolant, e.g., water, occupying cavities in the concrete shielding structure of the reactor. The concrete walls of these cavities may be tightly covered with steel sheet. Preferably, the reactor pressure vessel and the support structure of the reactor core are hollow so that a liquid coolant may circulate through this support structure, which comprises suitably a plurality of vertical hollow columns supporting both the reactor pressure vessel and the reactor core located inside the vessel. (NPO)

Research Reactors

6238 (HMI-B-20) DAS STRAHLUNGSFELD DES BER. (The Radiation Field of the BER). H. Buchholz and K. Wasserroth (Hahn-Meitner-Institut für Kernforschung, Berlin). Nov. 1961. 17p.

The main physical characteristics of the BER, the neutron fluxes, and the γ-dose rates in its experimental facilities are presented. The maximum values are: thermal neutron flux n_{th}, $\overline{v}_T$: $\Phi_{th} = 0.86 \cdot 10^{12}$ cm^{-2} sec^{-1}; resonance neutron flux, $\theta = 0.95 \cdot 10^{11}$ cm^{-2} sec^{-1}; gamma dose rate, $Dt_{\gamma} = 1.25 \cdot 10^{7}$ r · h. The time functions of the neutron fluxes and the γ-dose rates in the reactor and at the recombiner are presented. (auth)

6239 (TID-14394) PROGRESS OF NORA PROJECT. (Norway. Institutt for Atomenergi, Kjeller). Nov. 6, 1961. Contract AT(30-1)-2760. 7p. (NC-16, Annex I).

The progress of the NORA Project is reviewed. The status of the NORA facility is discussed and the experiments performed to date are described. (auth)

SPACE APPLICATIONS AND TECHNOLOGY

6240 (ASD-TR-61-662) CESIUM ION PROPELLANT SYSTEM. Final Report. Donald R. Snoke and Patrick J. Lawlor (Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland). Dec. 29, 1961. Contract AF33(616)-7219. 103p. (ER-4636)

The cesium ion propellant system consists of the hardware necessary to store, meter, vaporize, and superheat cesium to allow delivery of this vapor at the flow rate, pressure, and temperature consistent with the requirements of contact ion propulsion devices now under investigation. Results are presented of compatibility and handling studies for cesium, design and development of separate system components, and integration of the components into a laboratory system including the results of a one week endurance test. (auth)

6241 (D1-82-0124) LOSS MECHANISMS OF A LOW TEMPERATURE PLASMA ACCELERATOR. Flight Sciences Laboratory Report No. 45. Gordon C. Oates, J. Kenneth Richmond, Yoshio Aoki, and Gerhard Grohs (Boeing Scientific Research Labs., Seattle). July 1961. 54p.

An analysis was made of loss mechanisms of a low-temperature plasma accelerator. The principle loss mechanisms in these accelerators are those due to the electrode boundary layer and to Hall current effects. An experimental and theoretical investigation was carried out, using argon "seeded" with potassium, operating at a free stream temperature of 3000°K and at a pressure of about one atmosphere. (auth)

6242 (LAMS-2632) MISSION ANALYSIS FOR NUCLEAR PROPULSION. Ralph S. Cooper (Los Alamos Scientific Lab., N. Mex.). June 1961. Contract W-7405-Eng-36. 54p.

Elementary methods are presented for determining the performance of high thrust rockets with emphasis on nuclear propulsion. Simple models are used to describe the vehicles and to evaluate the mission requirements. Performance comparisons, both in general and for specific missions, are made of various propulsion systems using typical values for the system parameters. (auth)

6243 (NP-11176) ASTRONAUTICS INFORMATION. ABSTRACTS, VOLUME IV, NO. 5. Abstracts 4,428-4,521. B. J. Hardgrove and F. L. Warren, comps. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Nov. 1961. Contract NASw-6. 53p.

A bibliography on astronautics is presented covering the period of November 1961. The 93 references are on flight dynamics, vehicle technology, communications, guidance, control, manned flight, space medicine, and space science. Author, subject, and source indexes are included. (M.C.G.)

6244 (NP-11177) RESEARCH SUMMARY NO. 36-11, FOR THE PERIOD AUGUST 1, 1961—OCTOBER 1, 1961. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Nov. 1, 1961. Contract NASw-6. 99p.

Developments are reported in experimental space science, systems analysis, guidance and control research, communications system research, communications elements research, chemistry research, gas dynamic research, physics research, materials and engineering research, wind tunnels, liquid propulsion, and polymer research. (M.C.G.)

6245 (NP-11181) EFFECT OF LOW PRESSURE AT ELEVATED TEMPERATURES ON SPACE VEHICLE MATERIALS. E. A. DeWitt, S. Podlaseck, and J. Suhorsky (Martin Co. Materials Lab., Baltimore). Mar. 1959. 43p. (RM-29).

Forty-one selected nonmetals were exposed to vacua of 10^{-3} to 10^{-4} mm Hg at elevated temperatures for periods of 1.5 to 6 hr. These materials included plastics, elastomers, greases, potting compounds, sealants, adhesives, and electrical insulation. The pressures at which the materials were tested corresponded to simulated altitudes of 50 to 100 mi. Selected physical, chemical, and electrical testing of the before and after variety was conducted. No in vacuo testing was performed. Test data obtained from the vacuum exposed samples was compared with similar data obtained on samples exposed to the same temperatures at atmospheric pressure. Some of the materials tested were significantly affected by the high vacuum exposure. Among these were the neoprene and Buna-N elastomers, phenolic 91LD-Fiberglas laminate, Epon potting compound, Sealants PR 1422 and EC 801, and Greases MIL-G-10924, MIL-G-3278, and MIL-G-7118. (auth)

6246 (RAD-SR-61-173) THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF ARC PLASMA-GENERATION TECHNOLOGY. Quarterly Progress Report No. 5 [for period] August 1, 1961 to November 1, 1961. (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.). Nov. 15, 1961. Contract AF33(616)-7578). 70p.

A summary is presented of the results obtained on: high-pressure arc operation with low-contamination electrodes, operation of plasma generators with different gases, and alternating-current arc operation. Theoretical and experimental efforts were concentrated on investigation of the characteristics of the constricted arc configuration. Calculations were made of the radiation losses from a fully developed laminar constricted arc column in air at atmospheric pressure versus current and voltage gradient. Experimental data were obtained on arc characteristics and heat balance of a constricted arc with 1 inch diameter, 1, 2, and 4 inches long constrictor. The theory for the electron emission from and heat losses to a quasi-thermionic cathode was developed further. Rail electrode attrition rates operating in air were measured for various electrode materials. Heat flux to the anode of an arc instrumented with thermocouples was measured as a function of the magnetic field which rotates the arc. Arc characteristics in nitrogen were obtained using the confined arc configuration previously used for measurements in other gases. Equipment for similar measurements in fluorine was received. Additional calorimeter measurements were obtained on the exhaust from the 60 cycle a-c arc unit. A heat balance was made to determine how the heat losses are distributed. (auth)

6247 RECENT ADVANCES IN MAGNETOHYDRODYNAMIC PROPULSION. Meredith C. Gourdine (Plasmadyne Corp., Santa Ana, Calif.). ARS (Am. Rocket Soc.) J., 31: 1670-7(Dec. 1961).

For missions in the gravitational field of Earth and moon, specific impulses in the range 1500 to 5000 sec are desired for maximum payload. The only electrical system capable of operating efficiently in this range appears to be an MHD propulsor. Furthermore, of the three types of MHD propulsors (series, shunt, and induction), the shunt-type seems most suitable. Both series and induction propulsors are transient devices, and their performance to date indicates they will probably operate at specific impulses greater than 10,000 sec. On the other hand, the shunt, or crossed field propulsor, provides much higher specific thrusts (1 psi) and is operated experimentally at a specific impulse of approximately 1500 sec. For missions beyond the moon, the series- and induction-type propulsors can become serious competition for the ion rocket because they can potentially develop specific thrusts 100 to 1000 times as high as present ion rockets. At present, the series-type propulsor is more developed than induction-type MHD propulsors; it is almost ready for flight testing. The induction-type propulsor is still undergoing intensive laboratory study, and it is too early to prognosticate on its future in electrical propulsion. (N.W.R.)

6248 THEORETICAL PERFORMANCE OF PROPELLANTS SUITABLE FOR ELECTROTHERMAL JET ENGINES. John R. Jack (NASA Lewis Research Center, Cleveland). ARS (Am. Rocket Soc.) J., 31: 1685-9(Dec. 1961).

The performance of eight possible propellants for electrothermal jet engines is evaluated theoretically. Performance characteristics are presented for enthalpies up to 200,000 Btu/lb, temperatures as high as 45,000°R, pressures ranging from 0.01 to 100 atm, and specific impulses from 500 to 2000 sec. Of the propellants studied, hydrogen and helium appear to be the best for specific impulse in the vicinity of 1000 sec. At specific impulses greater than 1600 sec, lithium becomes more efficient. (auth)

6249 PLASMA PROPULSION WITH A PULSED TRANSMISSION LINE. Allan Schaffer (Aerospace Corp., Los Angeles). ARS (Am. Rocket Soc.) J., 31: 1718-22 (Dec. 1961).

When a current pulse is sent down a helical transmission line, the radial component of the fringing magnetic field acts like a piston on plasma ahead. This study leads to expressions for the resulting velocity and pressure of the plasma. The principal assumption is that leakage of the plasma through the magnetic piston is negligible. The analysis is based on the simultaneous solution of the transmission line equations, the conservation of energy, and the normal shock relationships. The analysis involves only algebraic equations, even though the usual simplifying assumption that the magnetic pressure equals the plasma pressure is not made. It is shown that the piston is always slowed down by the presence of the plasma. The distribution of the energy supplied to the device is traced. The results of the analysis are applied to a typical design problem. (auth)

6250 NUCLEAR SAFETY ANALYSIS OF SNAP III FOR SPACE MISSIONS. W. Hagis, T. Dobry, and G. Dix (Martin Co., Baltimore). ARS (Am. Rocket Soc.) J., 31: 1744-51(Dec. 1961).

Snap III is an auxiliary power source using thermoelectric elements to convert decay heat from a radioisotope directly into electrical energy. The fate of the radioisotope fuel in the event of post orbital re-entry after a successful satellite mission or an abort during a launch attempt was investigated. The objective was to determine the locations of impact or the locations and altitudes of the radioisotopic fuel capsule during burnup that could result from all possible combinations of final stage booster thrust, misalignments, or failures. Burnup altitude for a post orbital re-entry was also determined for a 275-mile circular orbit. The safety of the mission was appraised with respect to the fate of the radiopolonium fuel for successful missions and for the spectrum of potential aborted missions. Seven general cases resulted from the 65 abort cases examined. Concurrent with the theoretical investigation, a safety experimental program was conducted. These tests involved both missile failure and aerodynamic forces. They included plasma jet, impact, shock, fire, and fallout tests. The results indicate that the Snap III would be acceptable for operational missions. The deposits resulting from dispersing the radioactive fuel during re-entries, from either successful or aborted missions, would be completely masked by the Po^{210} that is naturally present in soils all over the world. (auth)

6251 THRUST VECTOR DETERMINATION OF AN ION ENGINE BY DIFFERENTIAL COMPARISON WITH AN UNTHRUSTED ORBIT. James N. Hanson (Thomason Ramo Wooldridge Inc., Cleveland). ARS (Am. Rocket Soc.) J., 31: 1787-90(Dec. 1961).

The mathematics for computing the thrust acceleration vector of a space vehicle continuous propulsion system by purely celestial mechanical means is outlined. The effects of perturbations (Earth oblateness, drag, etc.) are deleted from the total thrust acceleration acting on the center of mass of a thrusted vehicle by the differential orbital comparison with a nearby unthrusted orbiting body. The input information for these computations is a knowledge of the comparison orbit and an accurate record of the vector separation of the comparison object center of mass from the thrusted vehicle center of mass. (auth)

6252 SPACEMEN MAY COMMUNICATE WITH GAMMA RAYS. Harold C. Hood. Electronics, 35: No. 2, 28-9(Jan. 12, 1962).

The practicality of gamma ray communication systems for space is discussed. The speculation comes from the fact that higher frequencies are needed for communication and gamma ray frequencies reach 10^{13} Mc. The systems, using by-product gammas from nuclear reactors, would be jam-proof. Because gammas are heavily scattered and absorbed in the atmosphere, their direct use would be limited to outer space. If one chops the gammas, it is possible to transmit low-quality talk at 3 kc for distances up to 10000 miles and Morse code at 1 cps up to one million miles with typical nuclear reactors of 100 kw power. A simplified description of such a system is described. (N.W.R.)

CORPORATE AUTHOR INDEX

This index contains entries for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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ä	**becomes**	**ae**
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As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number in that volume. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Published literature (journal article or book) is identifiable by the absence of a report number.

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All reports, translations, and patents abstracted in this issue are included in this index. Each item is listed by report number; this is followed by the abstract number and a brief notation regarding public availability. The index entries show, when known, which reports are on file in the depository libraries, which reports have been published in open-literature journals (journal citation given), and which reports can be purchased (source and price). Whenever a report is identified by more than one number, cross references from secondary to primary report numbers are cited.

The report number codes apply to AEC reports unless designated otherwise. Non-AEC reports are identified by parenthetical notes after the report codes; e.g., (non-AEC), (British), (Canadian), (French). The note (Misc.) identifies those codes used for both USAEC and non-AEC reports. The report numbers for the non-AEC reports in these series are marked with an asterisk (*). Patents are listed under the heading "PATENTS"; the country of origin is included in parentheses.

A comprehensive listing of both AEC and non-AEC report codes is contained in TID-85(2nd Rev.), *Report Number Series Used by the Technical Information Service in Cataloging Reports*. March 1960, $2.75 (OTS), and supplement, August 1960, $0.50 (OTS).

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DSIR	For sale by the Department of Scientific and Industrial Research, Lending Library Unit, 20 Chester Terrace, London, N. W. 1, England.
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GPO	For sale by the Superintendent of Documents, Government Printing Office, Washington 25, D. C.
IAEA	Available from the International Atomic Energy Agency.
JCL	For sale by the Special Libraries Association Translation Center, John Crerar Library, 86 E. Randolph Street, Chicago 1, Illinois.
NRC	For sale by the National Research Council of Canada, Ottawa, Ontario, Canada.
OTS	For sale by the Office of Technical Services, Department of Commerce, Washington 25, D. C.
USGS	Available free-of-charge from the U. S. Geological Survey, Washington 25, D. C.

(The symbols "ph," "mf," and "fs" are used to designate that copy is available only in photostat, microfilm, or facsimile (Xerox) form.)

Report No.	Abstract No.	Availability
A-AC–	**(Misc.)**	
82/G/L.650*	16-5597	
82/G/L.652*	16-5126	
82/G/L.654*	16-5153	
82/G/L.655*	16-5598	
82/G/L.659*	16-5148	See CRER-1000
82/G/L.661*	16-5114	
82/G/L.664*	16-5549	
82/G/L.666*	16-5154	
82/G/L.671*	16-5218	
82/G/L.690*	16-5550	
82/G/L.696*	16-5599	
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82/G/L.698*	16-5552	
82/G/L.701*	16-5147	See ARCRL-5
82/G/R.183*	16-5553	
AD–	**(Misc.)**	
257713*	16-5782	OTS
260876*	16-5840	
260997*	16-6080	See ARL-TN-60-166
261335*	16-5707	
AEC-tr–		
4454	16-5317	Dep.; $3.75(OTS)
4880	16-5408	Dep.(mc); $2.60(fs), $1.10(mf) JCL
4937	16-5726	Dep.(mc); $1.10(fs), $0.60(mf) JCL or OTS
4948	16-5727	Dep.(mc); $4.60(fs), $1.52(mf) JCL
4949	16-5728	Dep.(mc); $6.60(fs), $2.15(mf) JCL
AECL–	**(Canadian)**	
1382	16-5678	Dep.; $1.50(AECL)
AERE-C–	**(British)**	
R-2441	16-5367	Dep.(mc)
AERE-M–	**(British)**	
828	16-5697	Powder Met., No. 8: 37-41(1961)
AERE-R–	**(British)**	
3869	16-5751	Dep.; $0.49(BIS)
AF-SAM–	**(Non-AEC)**	
61-87	16-5219	
AFCRL–	**(Non-AEC)**	
661	16-5841	
AFOSR–	**(Misc.)**	
1562*	16-5456	
AFSWC-TR–	**(Non-AEC)**	
61-85	16-5916	OTS
AGN–	**(Misc.)**	
8036	16-5457	Dep.; $2.00(OTS)
ANL–		
6321	16-5752	Dep.; $0.75(OTS)
6443	16-6072	Dep.; $2.00(OTS)
6444	16-5554	Dep.; $0.50(OTS)
6452	16-6085	Dep.; $1.75(OTS)
ANL-FGF–		
250	16-5732	Acta Cryst. 14: 1301-2(1961)
APAE–	**(Misc.)**	
107	16-5753	Dep.; $2.00(OTS)
APAE-Memo–	**(Misc.)**	
296	16-6086	Dep.(mc); $6.60(fs), $2.12(mf) OTS
297	16-6087	Dep.(mc); $8.10(fs), $2.75(mf) OTS
298	16-6210	Dep.(mc); $4.60(fs), $1.55(mf) OTS
APDA–	**(Misc.)**	
144	16-5429	Dep.(mc); $13.50(fs), $6.11(mf) OTS
APEX–		
110	16-5600	Dep.(mc); $8.60(fs), $3.20(mf) OTS
117	16-5601	Dep.(mc); $3.60(fs), $1.16(mf) OTS
132	16-5458	Dep.(mc); $4.60(fs), $1.55(mf) OTS
155	16-5602	Dep.(mc); $10.10(fs), $4.07(mf) OTS
169	16-5263	Dep.(mc); $1.60(fs), $0.80(mf) OTS
170	16-5264	Dep.(mc); $1.10(fs), $0.80(mf) OTS
180	16-5368	Dep.(mc); $12.00(fs), $5.27(mf) OTS
200	16-5603	Dep.(mc); $5.60(fs), $1.82(mf) OTS
237	16-6088	Dep.(mc); $1.60(fs), $0.80(mf) OTS
254	16-5604	Dep.(mc); $5.60(fs), $1.82(mf) OTS
276	16-5679	Dep.(mc); $1.60(fs), $0.80(mf) OTS
284	16-5480	Dep.(mc); $1.10(fs), $0.80(mf) OTS
305	16-6089	Dep.(mc); $2.60(fs), $0.83(mf) OTS
307	16-5654	Dep.(mc); $2.60(fs), $1.04(mf) OTS
311	16-5854	Dep.(mc); $7.60(fs), $2.51(mf) OTS
338	16-6090	Dep.(mc); $2.60(fs), $0.92(mf) OTS
364	16-6091	Dep.(mc); $3.60(fs), $1.13(mf) OTS
377	16-6092	Dep.(mc); $1.60(fs), $0.80(mf) OTS
474	16-6093	Dep.(mc); $2.60(fs), $0.98(mf) OTS
482	16-6094	Dep.(mc); $8.10(fs), $2.81(mf) OTS
531	16-5298	Dep.(mc); $2.60(fs), $0.98(mf) OTS
ARCRL–	**(British)**	
5	16-5147	$0.91(BIS)
ARF–	**(Misc.)**	
2210-6*	16-5680	
ARL-TN–	**(Non-AEC)**	
60-166	16-6080	
AROD–	**(Non-AEC)**	
2319.2	16-6095	
ASD-TR–	**(Non-AEC)**	
61-301	16-5708	
61-339	16-5709	OTS
61-662	16-6240	OTS
AWRE-O–	**(British)**	
9/61	16-5299	Dep.
BAW–	**(Misc.)**	
1234	16-6096	Dep.; $2.50(OTS)
BLG–	**(Belgian)**	
58	16-5408	For translation see AEC-tr-4880
BMI-N–	**(Non-AEC)**	
44	16-5686	See NEPA-1517
BMI-X–		
117	16-5710	Dep.(mc); $1.60(fs), $0.80(mf) OTS
177	16-6097	Dep.(mc); $1.10(fs), $0.80(mf) OTS
184	16-5665	Dep.(mc); $1.60(fs), $0.80(mf) OTS
185	16-5681	Dep.(mc); $3.60(fs), $1.13(mf) OTS
BNL–		
5195	16-5136	Am. J. Physiol. 192: 1061-4(1961)
5411	16-6014	Nuclear Sci. and Eng. 11: 369-76(1961)
5450	16-5207	Radiation Research 15: 774-84(1961)
5455	16-5381	Intern. J. Appl. Radiation and Isotopes 12: 62-3(1961)
5682	16-5562	J. Geophys. Research 66: 4321(1961)
BRL-Memo–	**(Misc.)**	
1374*	16-5917	
BW-AED–		
501	16-6211	Dep.(mc); $21.00(fs), $9.66(mf) OTS
CEA–	**(French)**	
1892	16-5754	Dep.(mc)
1974	16-5395	Dep.
1976	16-5396	Dep.
2038	16-5481	Dep.
CEA-tr–	**(French)**	
A-978	16-5271	Dep.(mc); $1.10(fs), $0.80(mf) JCL
A-1014	16-5134	Dep.(mc); $1.60(fs), $0.80(mf) JCL
A-1015	16-5612	Dep.(mc); $2.60(fs), $0.86(mf) JCL
R-1251	16-5558	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
R-1339	16-5372	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
R-1369	16-5150	Dep.(mc); $3.30(fs), $1.19(mf) JCL or OTS
R-1389	16-5439	Dep.(mc); $2.60(fs), $0.86(mf) JCL or OTS
R-1393	16-5501	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
R-1398	16-5373	Dep.(mc); $10.50(fs), $4.16(mf) JCL or OTS
R-1400	16-5766	Dep.(mc); $3.60(fs), $1.22(mf) JCL or OTS
R-1401	16-5318	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
R-1402	16-5374	$2.60(fs), $1.04(mf) JCL or OTS
R-1410	16-5467	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
R-1416	16-5135	Dep.(mc); $2.60(fs), $0.86(mf) JCL or OTS
R-1423	16-5151	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
X-257	16-5694	Dep.(mc); $2.60(fs), $1.01(mf) JCL
X-258	16-5695	Dep.(mc); $2.60(fs), $0.95(mf) JCL
X-283	16-5632	Dep.(mc); $1.10(fs), $0.80(mf) JCL

Report No.	Abstract No.	Availability
X-290	16-5658	Dep.(mc); $1.10(fs), $0.80(mf) JCL
X-349	16-5633	Dep.(mc); $2.60(fs), $1.10(mf) JCL
X-404	16-5502	$1.10(fs), $0.80(mf) JCL
X-421	16-5659	Dep.(mc); $1.10(fs), $0.80(mf) JCL
X-422	16-6228	Dep.(mc); $2.60(fs), $0.95(mf) JCL
CF–	**(Oak Ridge National Lab.)**	
60-10-62(Rev.1)	16-5104	Dep.(mc); $8.10(fs), $2.78(mf) OTS
60-11-124(Rev.)	16-5265	Dep.(mc); $4.60(fs), $1.49(mf) OTS
61-5-109(Suppl.2)	16-5482	Dep.(mc); $1.60(fs), $0.80(mf) OTS
CISE-R–	**(Italian)**	
34	16-5666	See EURAEC-98
CNB–	**(Italian)**	
20	16-5155	Dep.(mc)
CNLM–		
2154	16-5711	Dep.(mc); $1.10(fs), $0.80(mf) OTS
COO–		
224	16-5156	Dep.(mc); $9.10(fs), $3.32(mf) OTS
CRER–	**(Canadian)**	
1000	16-5148	
CURF-R–	**(Canadian)**	
10	16-5669	See NP-11171
11	16-5719	See NP-11169
12	16-5306	See NP-11170
13	16-5115	See NP-11172
D–	**(Misc.)**	
1-82-0124*	16-6241	
1-82-0129*	16-5835	
DANATOM–	**(Danish)**	
05-61	16-5643	Dep.(mc)
DC–	**(Misc.)**	
52-28-55	16-5755	Dep.(mc); $3.60(fs), $1.40(mf) OTS
55-10-78	16-6098	Dep.(mc); $2.60(fs), $0.83(mf) OTS
55-11-112	16-5483	Dep.(mc); $1.60(fs), $0.80(mf) OTS
55-11-127	16-6073	Dep.(mc); $8.10(fs), $2.87(mf) OTS
57-1-141	16-5484	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-3-131	16-5430	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-7-42	16-5485	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-7-51	16-6074	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-7-57	16-5486	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DCL–		
57-1-129	16-6099	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DEG-Inf. Ser.–	**(British)**	
111	16-5673	Dep.
DESY-A–	**(German)**	
2.82	16-6031	Dep.(mc)
DLCS–		
3810301	16-5605	Dep.(mc); $1.60(fs), $0.80(mf) OTS
4000101	16-5487	Dep.(mc); $3.60(fs), $1.40(mf) OTS
DMIC–	**(Non-AEC)**	
163	16-5682	OTS
DP–		
579	16-5756	Dep.; $2.25(OTS)
623	16-5757	Dep.; $0.50(OTS)
630	16-6100	Dep.; $0.50(OTS)
648	16-5266	Dep.; $0.50(OTS)
659	16-5488	Dep.; $0.50(OTS)
DPC.CPh–	**(British)**	
59-566	16-5673	For translation see DEG-Inf. Ser-111
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
ER–	**(Misc.)**	
4636*	16-6240	See ASD-TR-61-662
EURAEC–		
93	16-5758	Dep.(mc); $8.10(fs), $2.84(mf) OTS
98	16-5666	Dep.(mc); $4.60(fs), $1.61(mf) OTS
115	16-5683	Dep.(mc); $3.60(fs), $1.16(mf) OTS
129	16-5712	Dep.(mc); $4.60(fs), $1.43(mf) OTS
160	16-5431	Dep.(mc); $11.50(fs), $5.00(mf) OTS
161	16-5489	Dep.(mc); $2.60(fs), $0.89(mf) OTS
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FTD-TT–	**(Non-AEC)**	
61-213	16-5503	OTS
GA–	**(Misc.)**	
1532	16-6212	Dep.; $2.75(OTS)
1738	16-6213	Dep.; $2.50(OTS)
2289	16-6214	Dep.; $2.25(OTS)
2525	16-5644	Dep.(mc); $11.50(fs), $4.76(mf) OTS
2706	16-5459	Dep.; $1.00(OTS)
GAMD–	**(Misc.)**	
231	16-6215	Dep.(mc); $1.60(fs), $0.80(mf) OTS
860	16-5713	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1330	16-6216	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1881	16-6101	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1931	16-5432	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2731	16-5300	Dep.(mc); $2.60(fs), $0.92(mf) OTS
GEAP–	**(Misc.)**	
3748*	16-5667	
3835	16-6217	Dep.(mc); $3.60(fs), $1.13(mf) OTS
GNEC–		
93	16-6218	Dep.(mc); $9.60(fs), $3.56(mf) OTS
126	16-6219	Dep.(mc); $11.50(fs), $4.97(mf) OTS
HEPL–	**(Misc.)**	
246*	16-5921	
HMI-B–	**(German)**	
20	16-6238	Dep.(mc)
HW–		
61417	16-6102	Dep.(mc); $1.60(fs), $0.80(mf) OTS
66537	16-5301	Dep.(mc); $2.60(fs), $1.04(mf) OTS
67240	16-5855	Dep.(mc); $3.60(fs), $1.40(mf) OTS
69403	16-5759	Dep.(mc); $1.60(fs), $0.80(mf) OTS
70049	16-5645	Dep.; $3.50(OTS)
70366	16-5490	Dep.(mc); $1.10(fs), $0.80(mf) OTS
71668	16-5460	Dep.(mc); $1.10(fs), $0.80(mf) OTS
I-A–	**(Misc.)**	
2049-12	16-5438	See TID-12561
IDO–		
16646	16-5760	Dep.; $1.50(OTS)
IS–		
219	16-5302	Dep.; $0.75(OTS)
JINR–	**(Russian)**	
D-788	16-5922	Dep.(mc)
P-699	16-5859	Dep.(mc)
P-764	16-5923	Dep.(mc)
P-769	16-6032	Dep.(mc)
P-771	16-5860	
P-772	16-5861	Dep.(mc)
P-777	16-5924	Dep.(mc)
P-782	16-5491	Dep.(mc)
P-783	16-6033	Dep.(mc)
P-786	16-5925	Dep.(mc)
P-787	16-6034	Dep.(mc)
P-789	16-5862	Dep.(mc)
P-801	16-5926	Dep.(mc)
P-802	16-5927	Dep.(mc)
P-805	16-5928	Dep.(mc)
P-806	16-5929	Dep.(mc)
P-808	16-6035	Dep.(mc)
JPRS–	**(Non-AEC)**	
11184	16-5409	OTS
11242	16-5160	OTS
11288	16-5504	OTS
11423	16-5398	OTS
JÜL–	**(German)**	
10-RE	16-6103	Dep.(mc)
17-PP	16-6041	Dep.(mc)
18-PP	16-6042	Dep.(mc)
19-PP	16-6043	Dep.(mc)
20-RE	16-5492	Dep.(mc)
21-ST	16-5606	Dep.(mc)
22-PP	16-6044	Dep.(mc)
KAPL-M–		
EC-11	16-5461	Dep.(mc); $4.60(fs), $1.61(mf) OTS

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EC-13	16-5646	Dep.(mc); $1.60(fs), $0.80(mf) OTS
EC-14	16-5647	Dep.(mc); $3.60(fs), $1.31(mf) OTS
HP-10	16-5607	Dep.(mc); $2.60(fs), $0.89(mf) OTS
PF-9	16-5462	Dep.(mc); $2.60(fs), $0.98(mf) OTS
LA–		
2618	16-5774	Dep.; $1.50(OTS)
2643	16-5930	Dep.; $2.50(OTS)
2644	16-6220	Dep.; $1.75(OTS)
LAMS–		
2539(Suppl.)	16-5648	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2624	16-5775	Dep.; $1.10(fs), $0.80(mf) OTS
2632	16-6242	Dep.; $5.60(fs), $1.82(mf) OTS
2633	16-6045	Dep.; $2.60(fs), $0.92(mf) OTS
2647	16-6104	Dep.; $0.50(OTS)
LAR–		
55	16-5303	Dep.(mc); $8.10(fs), $2.66(mf) OTS
MAB–	**(Non-AEC)**	
178-M	16-5267	
MCW–		
1456	16-5405	Dep.; $0.50(OTS)
MF–	**(Misc.)**	
22	16-6047	See NYO-9762
MND-E–	**(Misc.)**	
2655*	16-5668	
MPR-X–		
11-61	16-5463	See TID-14439
NAA-SR–		
6213	16-5684	Dep.; $0.50(OTS)
6431	16-5685	Dep.; $1.00(OTS)
6646	16-6105	Dep.; $1.00(OTS)
NAS-NS–	**(Misc.)**	
3049	16-5369	Dep.; $0.50(OTS)
NB–	**(Non-AEC)**	
61-349	16-5608	Dep.(mc); $15.00(fs), $6.92(mf) OTS
NC–	**(Norwegian)**	
16, Annex I	16-6239	See TID-14394
NDL-TR–	**(Non-AEC)**	
13	16-5493	
NEPA–	**(Misc.)**	
905*	16-5761	$8.60(fs), $3.20(mf) OTS
934*	16-5304	$1.60(fs), $0.80(mf) OTS
935*	16-5305	$1.10(fs), $0.80(mf) OTS
947*	16-5655	Dep.(mc); $3.60(fs), $1.43(mf) OTS
1050*	16-5714	$2.60(fs), $0.92(mf) OTS
1100*	16-6106	$4.60(fs), $1.61(mf) OTS
1207*	16-6107	$4.60(fs), $1.70(mf) OTS
1517*	16-5686	$6.60(fs), $2.30(mf) OTS
1783*	16-6108	$3.60(fs), $1.19(mf) OTS
NMI–	**(Misc.)**	
2098	16-5715	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2099	16-5656	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NP–	**(AEC File No. for Non-AEC Reports)**	
10972	16-5716	
11141	16-5776	
11145	16-5433	
11164	16-6046	
11166	16-5717	
11167	16-5718	
11169	16-5719	
11170	16-5306	
11171	16-5669	
11172	16-5115	
11176	16-6243	
11177	16-6244	
11178	16-5720	
11179	16-5105	
11180	16-5307	
11181	16-6245	
11182	16-5721	
11190	16-5494	
11192	16-5434	OTS

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11193	16-5762	OTS
11194	16-5722	OTS
11201	16-5777	
11203	16-5863	Dep.(mc)
11204	16-5495	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
820	16-5375	
NRL–	**(Misc.)**	
5702*	16-5723	
NYO–		
9555	16-5799	J. Math. Phys. 2: 772-5(1961)
9573	16-5116	Dep.(mc); $4.60(fs), $1.55(mf) OTS
9584	16-5687	Dep.(mc); $3.60(fs), $1.22(mf) OTS
9585	16-5496	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9683	16-6036	Dep.(mc); $2.60(fs), $0.92(mf) OTS
9699	16-5626	Dep.(mc); $9.60(fs), $3.80(mf) OTS
9762	16-6047	Dep.(mc); $11.00(fs), $4.43(mf) OTS
ORNL–		
3169	16-5497	Dep.; $1.25(OTS)
3171	16-5670	Dep.; $0.75(OTS)
3184	16-5688	Dep.; $0.50(OTS)
3205	16-5931	Dep.; $1.50(OTS)
3221	16-6109	Dep.; $1.00(OTS)
ORNL-TM–		
75	16-5435	Dep.(mc); $1.60(fs), $0.80(mf) OTS
94	16-5689	Dep.(mc); $1.10(fs), $0.80(mf) OTS
99	16-6110	Dep.(mc); $2.60(fs), $0.89(mf) OTS
102	16-5436	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORO–		
477	16-5690	Dep.(mc); $1.60(fs), $0.80(mf) OTS
480	16-5127	Dep.(mc); $1.60(fs), $0.80(mf) OTS
506	16-6111	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PAN–	**(Polish)**	
138	16-5308	Dep.
139	16-5309	Dep.
262/V	16-5406	Dep.
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208,419	16-5413	
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216,401	16-6129	
216,622	16-6130	
216,706	16-6131	
217,241	16-5416	
217,288	16-5417	
218,462	16-6132	
218,926	16-6133	
218,998	16-5418	
221,302	16-6134	
221,854	16-5401	
222,477	16-6135	
222,604	16-6136	
222,631	16-5419	
222,673	16-6137	
222,838	16-5420	
223,336	16-6138	
223,431	16-5701	
223,664	16-5702	
223,777	16-5422	
223,914	16-5423	
224,625	16-6139	
225,692	16-5703	
225,822	16-6058	
225,934	16-5424	
226,144	16-5425	
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228,060	16-6141	
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228,249	16-5365	
228,844	16-5749	
229,115	16-5705	
229,411	16-5402	
229,523	16-5403	
230,559	16-6142	
230,595	16-6143	
231,333	16-6061	
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231,811	16-6144	
231,836	16-5426	
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232,502	16-6145	
233,299	16-5421	
233,492	16-6234	
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884,975	16-5664	
884,981	16-5447	
884,999	16-5392	
885,060	16-5427	
885,061	16-5428	
885,102	16-5547	
885,128	16-5393	
885,259	16-5625	
885,292	16-5475	
885,398	16-5476	
885,470	16-5366	
885,549	16-5448	
885,707	16-5449	
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885,781	16-5450	
885,882	16-6150	
885,885	16-6151	
PATENTS	**(Czech.)**	
88,292	16-5659	For French translation see CEA-tr-X-421
PATENTS	**(Dutch)**	
42,704	16-5632	For French translation see CEA-tr-X-283
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72,557	16-6152	See French Patent 1,188,113(Add.1)
72,942	16-6153	See French Patent 1,188,113(Add.2)
73,963	16-6163	See French Patent 1,226,423(Add.1)
74,730	16-5641	See 1,203,343(Add.)
74,930	16-5477	See French Patent 1,199,599(Add.1)
74,947	16-6164	See French Patent 1,226,423(Add.2)
1,188,113(Add.1)	16-6152	
1,188,113(Add.2)	16-6153	
1,189,249(Add.1)	16-6154	
1,199,599(Add.1)	16-5477	
1,203,343(Add.)	16-5641	
1,211,483	16-5451	
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1,216,839	16-6155	
1,217,960	16-6156	
1,218,965	16-5394	
1,222,147	16-6157	
1,222,604	16-6062	
1,223,882	16-6158	
1,224,960	16-6159	
1,225,402	16-6160	
1,225,768	16-6161	
1,225,784	16-6162	
1,226,423(Add.1)	16-6163	
1,226,423(Add.2)	16-6164	
1,226,818	16-5452	
1,227,775	16-6063	
1,228,195	16-6165	
1,228,326	16-6166	
1,228,359	16-6167	
1,228,660	16-5478	
1,228,812	16-5453	
1,228,851	16-6168	
1,229,281	16-6169	
1,229,381	16-6170	
1,229.393	16-6064	
1,229,729	16-6235	
1,229,777	16-6171	
1,229,778	16-6172	
1,229,780	16-6173	
1,229,865	16-6174	
1,230,011	16-6175	
1,230,019	16-6176	
1,230,022	16-6177	
1,230,023	16-6178	
1,230,024	16-6179	
1,230,196	16-6236	
1,230,538	16-6180	
1,230,563	16-6181	
1,230,564	16-6182	
1,230,565	16-6183	
1,230,661	16-6065	
1,230,672	16-6066	
1,230,954	16-6184	
1,231,675	16-6185	
1,232,353	16-6186	
1,232,354	16-6187	
1,232,423	16-6188	
1,232,607	16-6189	
1,232,989	16-6190	
1,233,073	16-6067	
1,233,085	16-6191	
1,233,492	16-5454	
1,233,894	16-6068	
1,233,935	16-6192	
1,233,936	16-6193	
1,233,964	16-6194	
1,234,038	16-6195	
1,234,173	16-6196	
1,234,543	16-6237	
1,234,624	16-5479	
1,235,225	16-6197	
1,235,347	16-6079	
1,236,090	16-6198	
1,236,554	16-6199	
1,237,444	16-6200	
1,238,675	16-6201	
1,239,361	16-6202	
1,240,419	16-6203	
1,240,960	16-6204	
1,241,050	16-6205	
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1,243,242	16-6070	
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348,085	16-5694	Included in French translation CEA-tr-X-257
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PATENTS	**(Japanese)**	
172,312	16-5658	For French translation see CEA-tr-X-290
PATENTS	**(Swedish)**	
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124,557	16-5501	For French translation see CEA-tr-R-1393
133,538	16-5503	For translation see FTD-TT-61-213
PM-R–	**(Canadian)**	
61-9	16-5669	See CURF-R-10
61-16	16-5719	See CURF-R-11
PST-Cat.–		
376	16-5317	See AEC-tr-4454
PWAC–	**(Misc.)**	
318*	16-5437	
R–	**(Misc.)**	
61APE60*	16-5667	See GEAP-3748
452.20-61*	16-5776	See NP-11141
RAD-SR–	**(Non-AEC)**	
61-173	16-6246	
RD-R–	**(Non-AEC)**	
60-80	16-5721	See SP-TP-24
RISÖ–	**(Danish)**	
19	16-6112	Dep.(mc)
RM–	**(Misc.)**	
29*	16-6245	See NP-11181
2798-AEC	16-5106	Dep.(mc); $2.60(fs), $1.04(mf) OTS
SB–	**(Non-AEC)**	
61-40	16-5722	See NP-11194
61-57	16-5434	See NP-11192
61-58	16-5762	See NP-11193
SCDC–		
2516	16-5657	See TID-14423
SCL-T–		
396	16-5729	Dep.(mc); $1.60(fs), $0.80(mf) JCL
SCR–		
163	16-5107	Dep.; $0.50(OTS)
306	16-5691	Dep.; $1.75(OTS)
442	16-5763	Dep.(mc); $1.60(fs), $0.80(mf) OTS
450	16-5764	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SCTM–		
248-61(72)	16-5498	Dep.(mc); $2.60(fs), $0.89(mf) OTS
257-61(14)	16-5778	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SIT-P–	**(Misc.)**	
41	16-6048	See TID-14082
SP-TP–	**(Non-AEC)**	
24	16-5721	See NP-11182
SRO–		
61	16-6221	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SRS-TR–	**(Non-AEC)**	
31-(383)	16-5495	See NP-11204
TID–		
3570	16-5609	Dep.; $0.50(OTS)
5360(Suppl.3) (Rev.)	16-5610	Dep.; $0.75(OTS)
12561	16-5438	Dep.(mc); $15.00(fs), $6.89(mf) OTS
13828	16-5310	Dep.; $0.50(OTS)
14082	16-6048	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14212	16-5157	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14306	16-6049	Dep.(mc); $2.60(fs), $0.98(mf) OTS
14316	16-5158	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14328	16-5268	Dep.(mc); $3.60(fs), $1.22(mf) OTS
14329	16-5407	Dep.(mc); $2.60(fs), $1.04(mf) OTS
14361	16-5311	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14370	16-5312	Dep.(mc); $5.60(fs), $1.76(mf) OTS
14371	16-5128	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14372	16-5129	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14373	16-5130	Dep.(mc); $3.60(fs), $1.19(mf) OTS
14374	16-5149	$1.60(fs), $0.80(mf) OTS
14384	16-5313	Dep.(mc); $2.60(fs), $0.95(mf) OTS
14388	16-5131	Dep.(mc); $10.50(fs), $4.19(mf) OTS
14394	16-6239	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14396	16-5779	Dep.(mc); $4.60(fs), $1.46(mf) OTS
14418	16-5108	Dep.(mc); $12.50(fs), $5.39(mf) OTS
14419	16-6222	Dep.(mc); $7.60(fs), $2.42(mf) OTS
14420	16-5132	Dep.(mc); $3.60(fs), $1.28(mf) OTS
14423	16-5657	Dep.(mc); $4.60(fs), $1.67(mf) OTS
14424	16-5611	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14429	16-5765	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14432	16-5133	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14436	16-6113	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14439	16-5463	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14441	16-5370	Dep.(mc); $2.60(fs), $1.04(mf) OTS
14461	16-5780	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14462	16-5464	Dep.(mc); $12.00(fs), $5.09(mf) OTS
14463	16-5159	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14467	16-5671	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14468	16-5314	Dep.(mc); $3.60(fs), $1.31(mf) OTS
14469	16-6114	Dep.(mc); $2.60(fs), $0.92(mf) OTS
14471	16-5555	Dep.(mc); $3.60(fs), $1.16(mf) OTS
TR–	**(Misc.)**	
61-103-1*	16-5716	See NP-10972
UCRL–		
6330-T(Rev.)	16-5781	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6465	16-5836	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6605	16-5109	Dep.; $0.75(OTS)
6636	16-5110	Dep.; $1.00(OTS)
9846	16-5371	Dep.; $2.00(OTS)
9900	16-5117	Dep.; $2.00(OTS)
13026	16-5556	Dep.(mc); $8.10(fs), $2.75(mf) OTS
13028	16-5111	Dep.(mc); $8.60(fs), $3.17(mf) OTS
13030	16-5557	Dep.(mc); $9.60(fs), $3.74(mf) OTS
UCRL-Trans–		
699(L)	16-5783	Dep.(mc); $3.60(fs), $1.25(mf) JCL
759	16-5864	Dep.(mc); $3.60(fs), $1.16(mf) JCL or OTS
760(L)	16-5784	Dep.(mc); $1.60(fs), $0.80(mf) JCL
USNRDL-TR–	**(Non-AEC)**	
525	16-5112	
533	16-6075	
534	16-5465	
WADC-TR–	**(Misc.)**	
59-575(Pt.II)*	16-5672	OTS
WADD-TR–	**(Non-AEC)**	
60-184(Pt.II)	16-5724	OTS
60-917	16-5692	OTS
61-72(Vol.I)	16-5725	OTS
61-123	16-5315	OTS
WAL-TR–	**(Non-AEC)**	
823/2	16-5269	$0.50(OTS)
WAPD-AD–		
TH-512	16-5499	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WAPD-MRP–		
94	16-6223	Dep.; $2.50(OTS)
WAPD-T–		
1221	16-5270	$1.60(fs), $0.80(mf) OTS
1294	16-5397	Dep.(mc); $2.60(fs), $0.92(mf) OTS
1306	16-6078	Nuclear Sci. and Eng. 11: 450-1(1961)
1318	16-6224	Dep.(mc); $2.60(fs), $0.95(mf) OTS
1378(Rev.1)	16-6225	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1380	16-5500	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1384	16-5918	Dep.(mc); $2.60(fs), $0.95(mf) OTS
1385	16-5932	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1387(Rev.1)	16-6226	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1404	16-5856	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WAPD-TM–	**(Misc.)**	
252	16-5649	Dep.; $1.25(OTS)
308	16-6115	Dep.; $0.50(OTS)
WCAP–	**(Misc.)**	
1409	16-5857	Dep.(mc); $1.10(fs), $0.80(mf) OTS
WIS-AEC–		
6	16-5316	Dep.(mc); $3.60(fs), $1.22(mf) OTS
XDC–		
54-12-17	16-6088	See APEX-237
55-9-158	16-6116	Dep.(mc); $14.50(fs), $6.53(mf) OTS
55-11-117	16-5466	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-1-32	16-6076	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-6-129	16-5858	Dep.(mc); $3.60(fs), $1.37(mf) OTS
58-1-137	16-6117	Dep.(mc); $2.60(fs), $1.10(mf) OTS
58-4-64	16-6227	Dep.(mc); $2.60(fs), $0.89(mf) OTS